

AD-A106 617

AIR FORCE GEOPHYSICS LAB HANSCOM AFB MA
DEVELOPMENT OF A LARGE SCALE CLOUD SYSTEM, 23-27 MARCH 1978. (U)

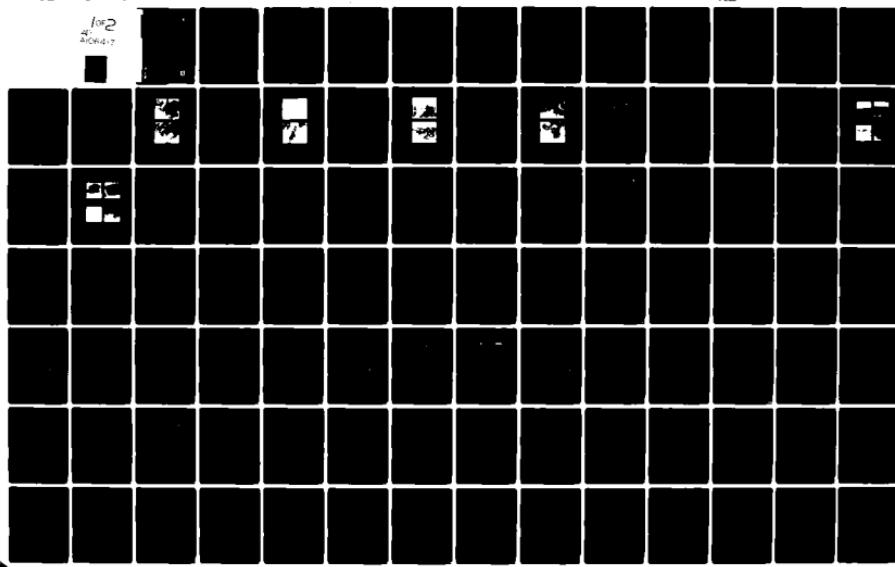
F/8 8/2

UNCLASSIFIED

MAY 81 I D COMEN
AFGL-TR-81-0127

NL

102
AFGL-TR-81-0127



ADA106417

LEVEL
P

AFGL-TR-81-0127
ENVIRONMENTAL RESEARCH PAPERS, NO. 739



Development of a Large Scale Cloud System, 23—27 March 1978

IAN D. COHEN, Capt, USAF

4 May 1981

Approved for public release; distribution unlimited.

DTIC
SELECTED
S NOV 2 1981
A

METEOROLOGY DIVISION PROJECT 2310
AIR FORCE GEOPHYSICS LABORATORY
HANSCOM AFB, MASSACHUSETTS 01731

AMC FILE COPY

AIR FORCE SYSTEMS COMMAND, USAF



811030065

This report has been reviewed by the ESD Information Office (OI) and is releasable to the National Technical Information Service (NTIS).

This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER


John Howard
Chief Scientist

Qualified requestors may obtain additional copies from the Defense Technical Information Center. All others should apply to the National Technical Information Service.

Unclassified AFGL-ERP-739

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER AFGL-TR-81-0127	2. GOVT ACCESSION NO. AD-A106417	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) DEVELOPMENT OF A LARGE SCALE CLOUD SYSTEM, 23-27 MARCH 1978		5. TYPE OF REPORT & PERIOD COVERED Scientific. Interim.
6. AUTHOR(s) Ian D. Cohen Capt, USAF		6. PERFORMING ORG. REPORT NUMBER ERP No. 739
7. PERFORMING ORGANIZATION NAME AND ADDRESS Air Force Geophysics Laboratory (LYC) Hanscom AFB Massachusetts 01731		8. CONTRACT OR GRANT NUMBER(s)
9. CONTROLLING OFFICE NAME AND ADDRESS Air Force Geophysics Laboratory (LYC) Hanscom AFB Massachusetts 01731		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 61102F 2310G501 1765
11. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) Fusion Inc., 1200 17th Street, Suite 1000, Denver, CO 80202		12. REPORT DATE 4 May 1981
		13. NUMBER OF PAGES 112
		14. SECURITY CLASS. (of this report) Unclassified
		15. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION ST. (Enter if different from Report)		
18. SUPPLEMENTARY TES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Cloud microphysics Liquid water content Cloud particle spectra Storm development Convective cloud structure Ice water content Stratiform cloud structure		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The visual and microphysical properties of a large scale cloud system are described as that system developed from an open wave in Oklahoma to a deep occlusion covering most of the east coast of the United States. Microphysical properties examined include particle size, liquid water content, particle density, crystal type, and Form Factor (a measure of uniformity of particle size within a sample). Visual and microphysical observations were made at four levels, approximately at the 400, 400, 700, and 850-mb surfaces, on four consecutive days. On each day the MC-130E aircraft instrumented for cloud		

DD FORM 1 JAN 73 1473

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

407377

Unclassified

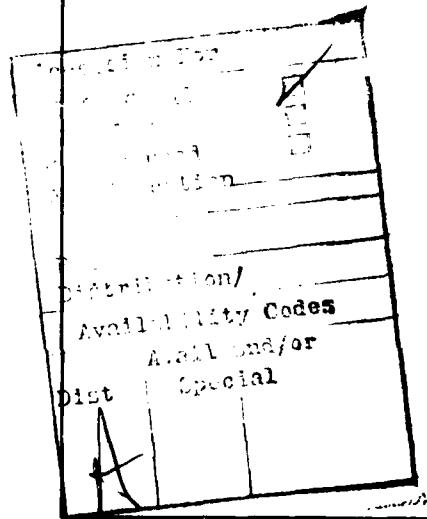
SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

20. (Cont)

physics research by AFGL flew at each level for approximately 30 minutes. In addition to examination of the continuous data provided by the aircraft, a detailed examination of 32 samples of 2 min each was undertaken.

Sampling was conducted in the northeast quadrant of the storm. During the first day, the storm was mainly convective in nature, and as a result, had high liquid water content and particle distributions which were uniform along the vertical axis. As the storm moved eastward, it became more stratified. As it did, the observed particle size and types showed greater variations. The upper levels were affected less than the lower levels, thus reducing the uniformity along the vertical axis. As the system occluded, it lost moisture, producing smaller hydrometeors, lower liquid water content, and lighter precipitation at the surface. Later, an influx of warm air increased the liquid water content and the intensity of the precipitation.

The 2-min samples showed that the Form Factor tended to be highest at the higher levels, often as high as 0.60, while it varied from 0.00 to 0.25 at lower levels. This showed a consistency of particle size and type in time and space in the upper levels while wide variations in particle size and type were occurring at lower levels.



Unclassified

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

Preface

The development and complete life cycle of large scale storms has long been of interest to meteorologists. The use of an aircraft with PMS probes and other cloud physics equipment has enabled us to look at both the visual and microphysical development of a large scale storm.

In order to gather the necessary aircraft data, the aircrew made four flights totalling approximately 21 hours in four days. Most of this time was spent in weather which aircrews prefer to avoid. Thus I extend my deepest appreciation for the efforts of the 4950th Test Wing and to the aircrew and maintenance personnel who participated on these missions.

The AFGL project crew, consisting of Capt (now Major) Donald Cameron, MSgt James Bush, TSgt Marshall Wright, and SSgt Dennis LaGross, did an outstanding job in maintaining and operating the project equipment and providing the visual and microphysical data upon which this report is based. Guidance in locating the optimum sampling areas was provided by Dr. Arnold A. Barnes, Jr., Mr. Robert Myers, and Capt (now Major) Leandro Delgado of AFGL, and Mr. John Powers of Systems and Applied Sciences Corp. using the AFGL Man-computer Interactive Data Access System (McIDAS).

Special thanks go to Lt Col Donald Varley and Dr. Arnold A. Barnes, Jr. for suggestions and assistance in the preparation of this report, to Mrs. Pat Sheehy for typing the manuscript, to Ms. Barbara Main for preparing the illustrations, and to Mr. James Lally of Digital Programming Services, Inc. for providing computer printouts and plots.

Contents

1. INTRODUCTION	9
2. SYNOPTIC SITUATION	11
3. THE FLIGHTS	21
3.1 Flight 78-10	22
3.2 Flight 78-11	22
3.3 Flight 78-12	23
3.4 Flight 78-13	23
4. VISUAL OBSERVATIONS OF THE CLOUDS	24
4.1 Upper Levels	24
4.2 Lower Levels	26
5. DATA PROFILES FOR EACH FLIGHT	26
5.1 23 March 1978	26
5.2 24 March 1978	28
5.3 25 March 1978	30
5.4 26 March 1978	30
6. DISCUSSION OF DATA	33
6.1 Crystal Types Encountered	33
6.2 Particle Size Distributions	34
6.3 Form Factor	37
6.4 Liquid Water Content	40
6.5 Particle Counts	44
6.6 Other Data	49
7. OBSERVED TWO-MINUTE PARTICLE DISTRIBUTIONS	50
7.1 Samples From 23 March 1978	50
7.2 Samples From 24 March 1978	56
7.3 Samples From 25 March 1978	57
7.4 Samples From 26 March 1978	67

Contents

8. OVERALL DISCUSSION	68
9. CONCLUDING COMMENTS	75
REFERENCES	77
ABBREVIATIONS	79
APPENDIX A: Mission Director's Comments	81
APPENDIX B: 30-Second Data Averages	97

Illustrations

1. Cloud Physics Equipment on MC-130E 40571	10
2. Synoptic Maps for 24 March 1978 at 0000Z	13
3. GOES East Satellite Photographs for 23 March	14
4. Synoptic Maps for 25 March 1978 at 0000Z	15
5. GOES East Satellite Photographs for 24 March	16
6. Synoptic Maps for 26 March 1978 at 0000Z	17
7. GOES East Satellite Photographs for 25 March	18
8. Synoptic Maps for 27 March 1978 at 0000Z	19
9. GOES East Satellite Photographs for 26 March	20
10. Track of the Main Low Pressure Area and Frontal Systems From 23 to 27 March	21
11. Clouds From 23,000 ft (7.1 km) on 23 March 1978	25
12. Clouds From 23,000 ft (7.1 km) on 24 March 1978	25
13. Clouds From 23,000 ft (7.1 km) on 25 March 1978	25
14. Clouds From 23,000 ft (7.1 km) on 26 March 1978	25
15. Clouds From 10,000 ft (3.0 km) on 23 March 1978	27
16. Clouds From 10,000 ft (3.0 km) on 24 March 1978	27
17. Clouds From 5,000 ft (1.5 km) on 25 March 1978	27
18. Clouds From 5,000 ft (1.5 km) on 26 March 1978	27
19. Profiles of (a) Altitude and Temperature, (b) Liquid Water Content, (c) Medium Volume Diameter, (d) Reflectivity, (e) Density, and (f) Form Factor With Time for the Flight of 23 March	28

Illustrations

20.	Profiles of (a) Altitude and Temperature, (b) Liquid Water Content, (c) Medium Volume Diameter, (d) Reflectivity, (e) Density, and (f) Form Factor With Time for the Flight of 24 March	29
21.	Profiles of (a) Altitude and Temperature, (b) Liquid Water Content, (c) Medium Volume Diameter, (d) Reflectivity, (e) Density, and (f) Form Factor With Time for the Flight of 25 March	31
22.	Profiles of (a) Altitude and Temperature, (b) Liquid Water Content, (c) Medium Volume Diameter, (d) Reflectivity, (e) Density, and (f) Form Factor With Time for the Flight of 26 March	32
23.	Typical 2-D Shadowgraphs	35
24.	Distributions of Particle Density vs Particle Size (equivalent melted diameter) for Each Pass During the Sampling Flights	36
25.	Form Factor at 400 mb for Each of the Four Days	38
26.	Form Factor at 500 mb for Each of the Four Days	39
27.	Form Factor at 700 mb for Each of the Four Days	40
28.	Form Factor at 850 mb for Each of the Four Days	41
29.	Liquid Water Content at 400 mb for Each of the Four Days	42
30.	Liquid Water Content at 500 mb for Each of the Four Days	43
31.	Liquid Water Content at 700 mb for Each of the Four Days	44
32.	Liquid Water Content at 850 mb for Each of the Four Days	45
33.	Particle Density (number of particles per cubic meter) at 400 mb for Each of the Four Days	46
34.	Particle Density (number of particles per cubic meter) at 500 mb for Each of the Four Days	47
35.	Particle Density (number of particles per cubic meter) at 700 mb for Each of the Four Days	48
36.	Particle Density (number of particles per cubic meter) at 850 mb for Each of the Four Days	49
37.	Sample Data From 400 mb - 23 March 1978	52
38.	Sample Data From 500 mb - 23 March 1978	53
39.	Sample Data From 700 mb - 23 March 1978	54
40.	Sample Data From 850 mb - 23 March 1978	55
41.	Sample Data From 400 mb - 24 March 1978	59
42.	Sample Data From 500 mb - 24 March 1978	60
43.	Sample Data From 700 mb - 24 March 1978	61
44.	Sample Data From 850 mb - 24 March 1978	62
45.	Sample Data From 400 mb - 25 March 1978	63
46.	Sample Data From 500 mb - 25 March 1978	64
47.	Sample Data From 700 mb - 25 March 1978	65
48.	Sample Data From 850 mb - 25 March 1978	66

Illustrations

49.	Sample Data From 400 mb - 26 March 1978	69
50.	Sample Data From 500 mb - 26 March 1978	70
51.	Sample Data From 700 mb - 26 March 1978	71
52.	Sample Data From 850 mb - 26 March 1978	72
53.	Average Form Factor of 2-min Samples vs Altitude for Each of the Four Sampling Flights	73
54.	Average Particle Size During 2-min Samples vs Altitude for Each of the Four Sampling Flights	74

Tables

1.	Flights of MC-130E #640571 on 23 to 27 March 1978	11
2.	Particle Types Encountered During Different Passes on the Flights of 23 to 27 March 1978	33

Development of a Large Scale Cloud System

23-27 March 1978

1. INTRODUCTION

During March 1978, the MC-130E of the 4950th Test Wing with AFGL Cloud Physics instrumentation gathered data on several storm systems in the eastern and central United States as a part of the AFGL Large Scale Cloud Systems (LSCS) project. The LSCS Project investigated changes in the microphysics of cyclonic storms as they developed and crossed the United States. This report will examine data obtained in one such storm system.

The MC-130E sampled a storm system from 23 to 26 March. On each of these days, the aircraft made a flight into the storm area and investigated the northeast quadrant of the storm. A single quadrant was chosen to provide a consistent view of the variations of meteorological conditions as the storm progressed through its life cycle. In this case, the northeast quadrant was chosen because of the large extent of clouds and precipitation which permitted long sampling paths in uniform stratiform clouds. The clouds in this quadrant were thick, which permitted productive sampling passes at 400, 500, 700, and 850 mb on each flight.

Areas of convective activity were generally avoided, as were those frontal surfaces which had strong wind gradients.

(Received for publication 30 April 1978)

Instrumentation on the aircraft is adequately described by Varley,¹ Knollenberg^{2,3,4} and others, and so will not be discussed in detail here. The standard configuration of probes was used on this series of flights. PMS 1-D and 2-D probes were located in the positions shown on Figure 1. The EWER probe (item 7 on Figure 1) is a new instrument designed to measure the total liquid water content of a sample of air. Data from the EWER probe were taken but were not used in the preparation of this report since the EWER was not considered reliable when these flights were made.

On 23 March the aircraft made three data passes in the Texas Panhandle and then flew four data passes in northeastern Oklahoma. On subsequent days, four passes were flown on each flight. Table 1 shows the times of the flights on each of the four days.

A recent report by Varley⁵ examined the large scale cloud system of 1 to 3 March 1978. His report contains a survey of work done in this field.

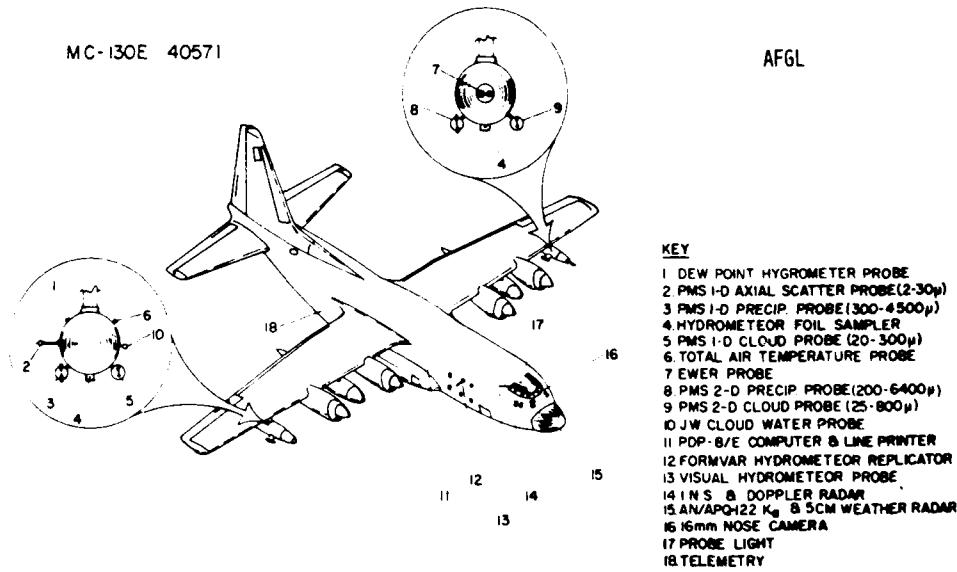


Figure 1. Cloud Physics Equipment on MC-130E 40571

(Due to the large number of references cited above, they will not be listed here. See References, page 77.)

Table 1. Flights of MC-130E, #640771 on 23 to 27 March 1978.

Flight	Date	Time	Location	Altitude	Flight Type	Flight Number
78-10	23 Mar	1200Z	Oklahoma	350 mb	Cloud Sampling	78-10
78-11	23 Mar	1800Z	Missouri	350 mb	Cloud Sampling	78-11
78-12	24 Mar	1200Z	Kentucky-Tennessee border	350 mb	Cloud Sampling	78-12
78-13	24 Mar	1800Z	Illinois	350 mb	Cloud Sampling	78-13
78-14	25 Mar	1200Z	Georgia	350 mb	Cloud Sampling	78-14
78-15	25 Mar	1800Z	Alabama	350 mb	Cloud Sampling	78-15
78-16	26 Mar	1200Z	Alabama	350 mb	Cloud Sampling	78-16
78-17	26 Mar	1800Z	Alabama	350 mb	Cloud Sampling	78-17
78-18	27 Mar	1200Z	Alabama	350 mb	Cloud Sampling	78-18
78-19	27 Mar	1800Z	Alabama	350 mb	Cloud Sampling	78-19

2. SYNOPTIC SITUATION

A synoptic analysis of this system was made by Chin and Hamilton,⁶ selected data and maps from their report have been included in this report.

On 23 March, a small low pressure area formed on a quasi-stationary front in Oklahoma. By 0000Z on 24 March (the approximate time of Flight 78-10, the first of the four flights) the low had become an open wave, as shown in Figure 2. Southerly winds at 350 mb brought warm, moist air into the system, while a 600 mb trough over west Texas helped the system intensify. The GOES satellite photos in Figure 3 show the extensive cloudiness ahead of the system and considerable convective activity associated with the storm at this stage of development. This convective activity was evident during Flight 78-10. Twenty-four hours later, the low had moved to Missouri, as seen in Figure 4. The deep 350-mb low continued to bring warm, moist air into the system resulting in a large area of cloudiness north of the warm front. The satellite photos in Figure 5 reveal the extent and depth of this cloudiness. Flight 78-11 obtained data in this cloud shield north of the front. The cloudiness was the result of the warm air overrunning the stationary front along the Kentucky-Tennessee border.

The system continued to deepen and by the afternoon of 25 March an occluded front connected the main low in Illinois to a secondary low in Georgia. Figure 6 shows this as well as the nearly vertical structure of the upper air low system. This is typical of a deep occlusion, as are the extensive areas of cloudiness seen in Figure 7. As the infrared photo shows, most of the higher clouds were ahead of the system. Flight 78-12 sampled clouds in the trailing edge of the more intense activity. By this time much of the convective character of the

6. Chin, D., and Hamilton, H.D. (1979) Synoptic Analysis Case 2, 23 March 1978, AFGL-TR-79-0007, AD A065555.

storm was gone. It was replaced by more extensive stratiform clouds and less intense but more widespread precipitation.

While the original low continued to drift eastward, it was the secondary low (formed in Georgia on 25 March) that dominated the weather in the eastern United States on 26 March. As Figure 8 shows, this low combined with the nearly vertical cyclonic system in Ohio to create strong southerly winds along the Atlantic coast which brought considerable moisture to eastern Pennsylvania and New York. Many stations from Virginia to New York reported moderate rain for much of the day. The satellite photos in Figure 9 show the extent of the cloud shield. The thickest clouds were associated with the warm front which extended from the low in Georgia to Long Island. Flight 78-13 occurred in the northern portion of this area. At 5,000 ft (1.5 km) the aircraft was often in rain, but not in clouds. The cloud shield consisted mainly of widespread stratiform clouds, much as it had been the day before. Convective activity was limited to an area in eastern North Carolina and over the ocean northeast of the secondary low, well away from the sampling aircraft.

A summary of the track of this storm and the sampling areas used on the four flights described in this report appear in Figure 10. Portions of the fronts which did not influence the flights have been omitted to avoid confusion.

During the four days the MC-130 investigated it, the system changed from a small, fast moving wave with considerable convective activity to a deep occlusion which spread uniform stratocumulus and nimbostratus overcasts over the entire eastern half of the United States. It brought widespread rain, freezing rain, and snow to much of the northeastern United States. This report will explore the changes in clouds and cloud structure during the period.

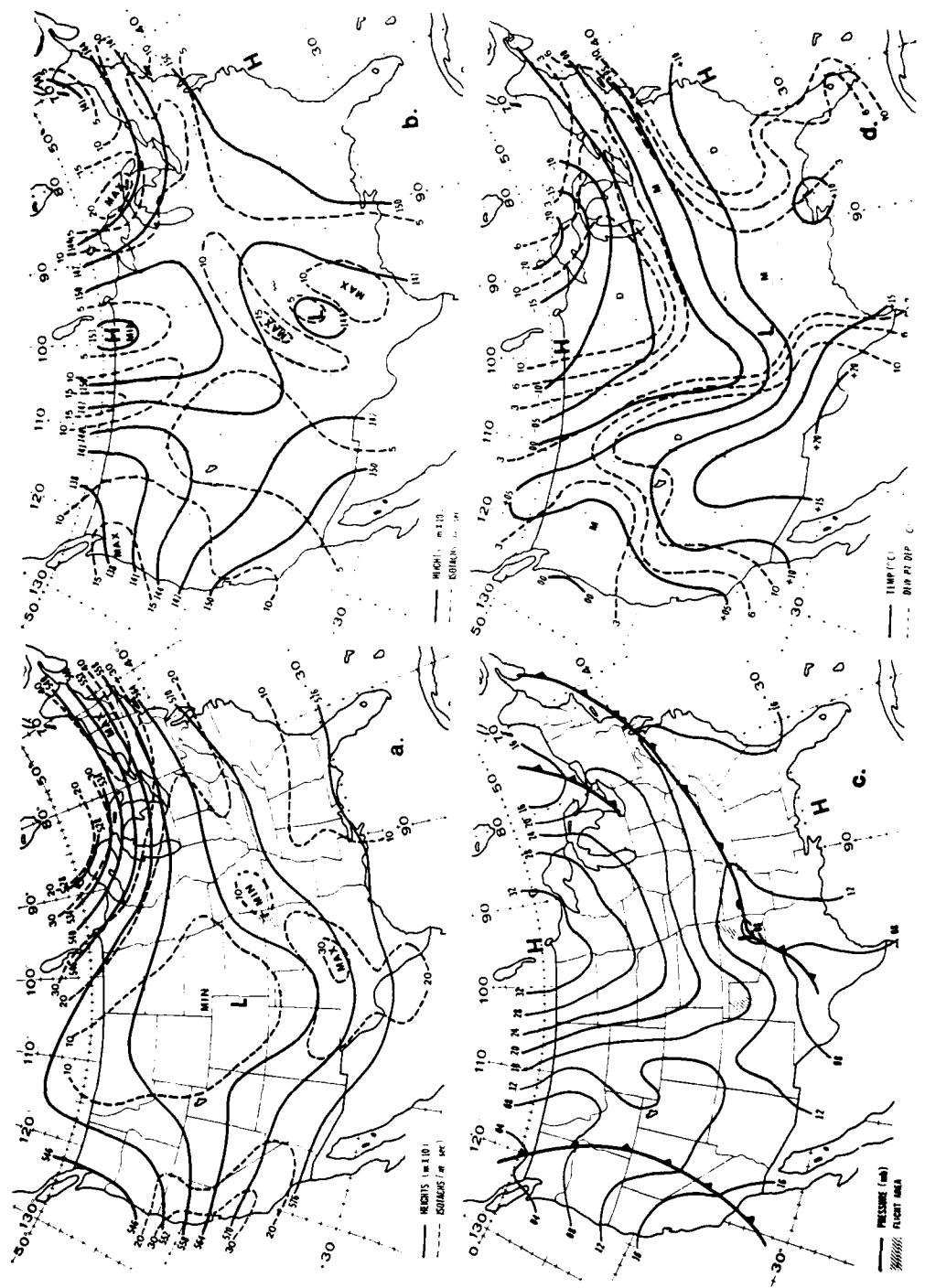


Figure 2. Synoptic Maps for 24 March 1978 at 0000Z. Charts show: (a) 500-mb heights and isotachs, (b) 850-mb heights and isotachs, (c) surface fronts and pressure patterns, (d) 850-mb temperature and moisture

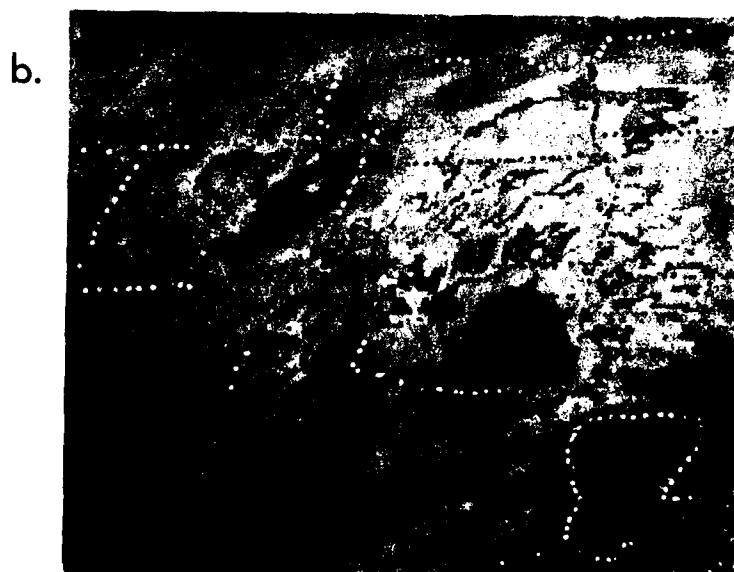
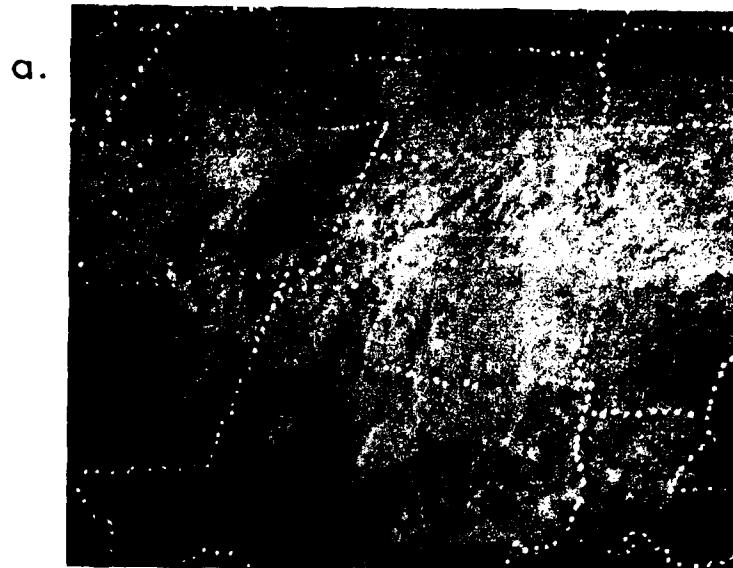


Figure 3. GOES East Satellite Photographs for 23 March.
(a) visible at 2300Z, (b) infrared at 2230Z

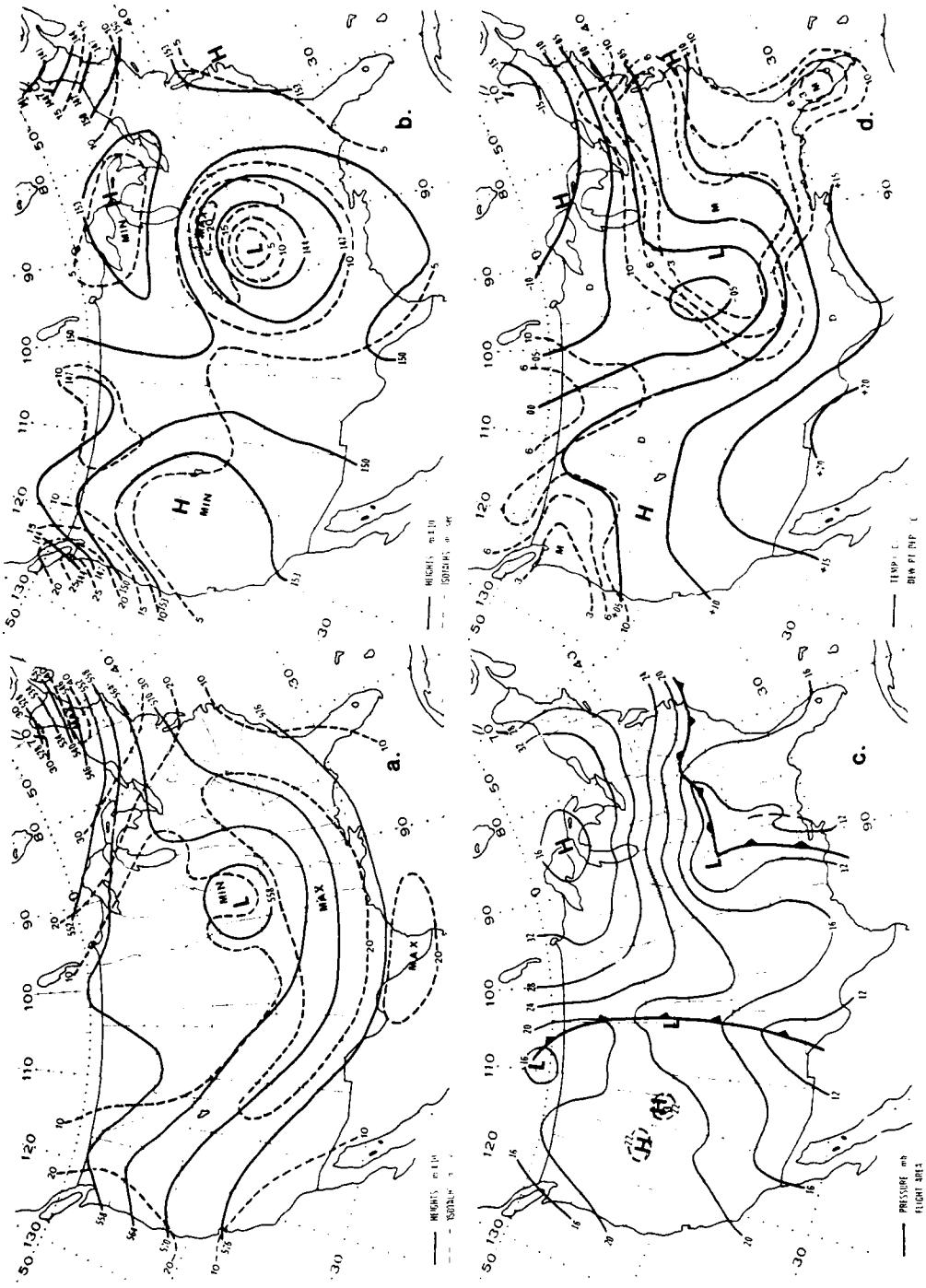


Figure 4. Synoptic Maps for 25 March 1978 at 0000Z. Charts show: (a) 500-mb heights and isotachs, (b) 850-mb heights and isotachs, (c) surface fronts and pressure patterns, (d) 850-mb temperature and moisture heights and isotachs.

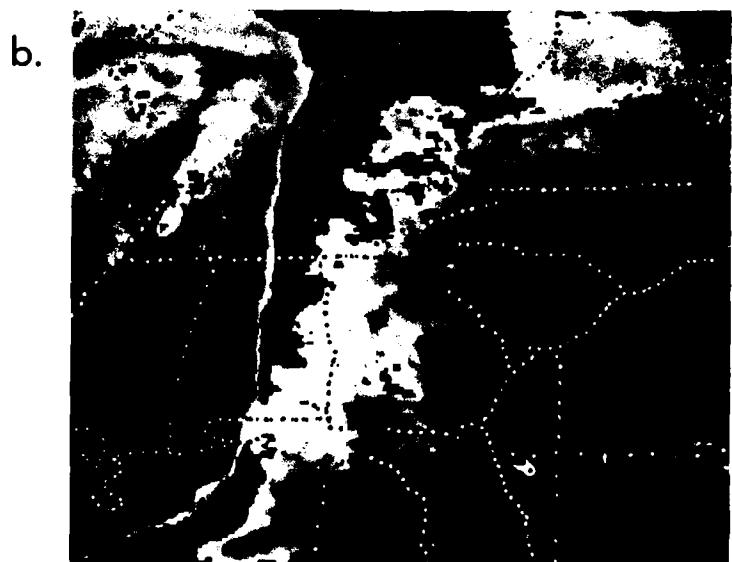


Figure 5. GOES East Satellite Photographs for 24 March,
(a) visible at 2230Z, (b) infrared at 2200Z

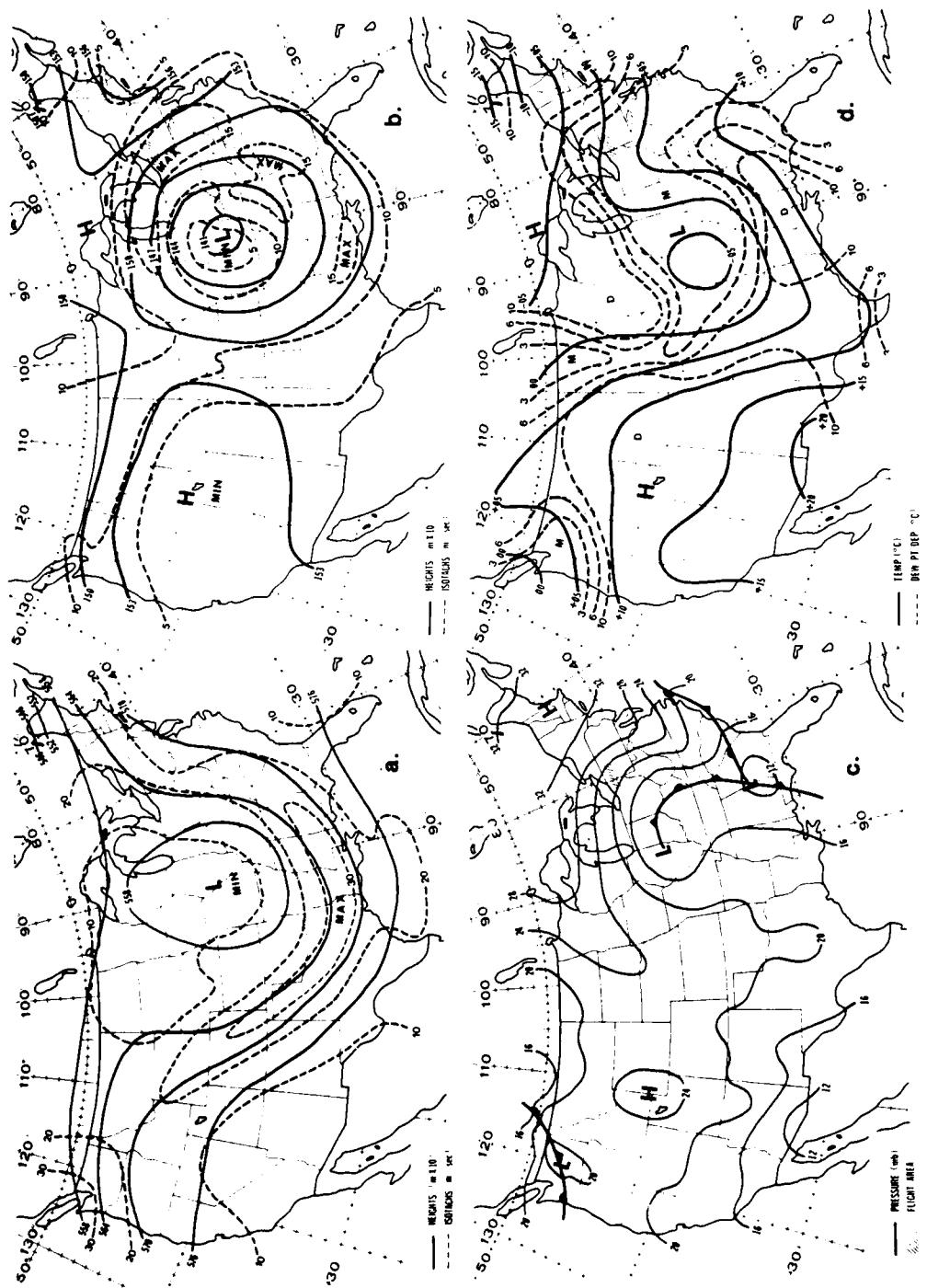


Figure 6. Synoptic Maps for 26 March 1978 at 0000Z. Charts show: (a) 500-mb heights and isotachs, (b) 850-mb heights and isotachs, (c) surface fronts and pressure patterns, (d) 850-mb temperature and moisture

a.



b.

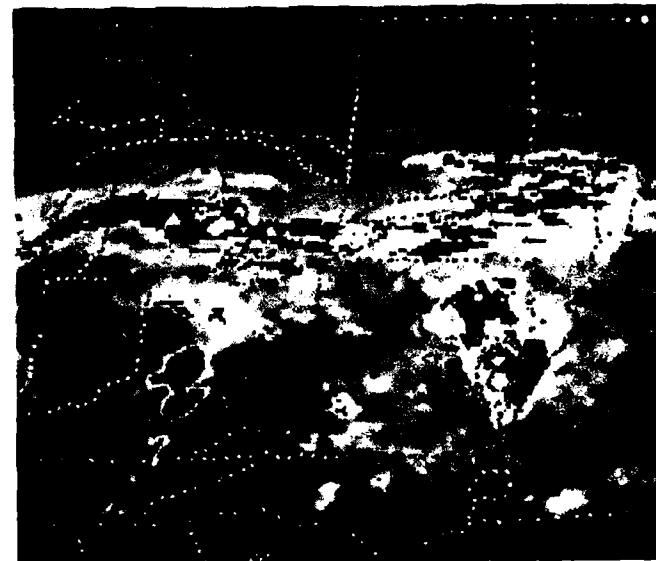


Figure 7. GOES East Satellite Photographs for 25 March.
(a) visible at 2030Z, (b) infrared at 2000Z

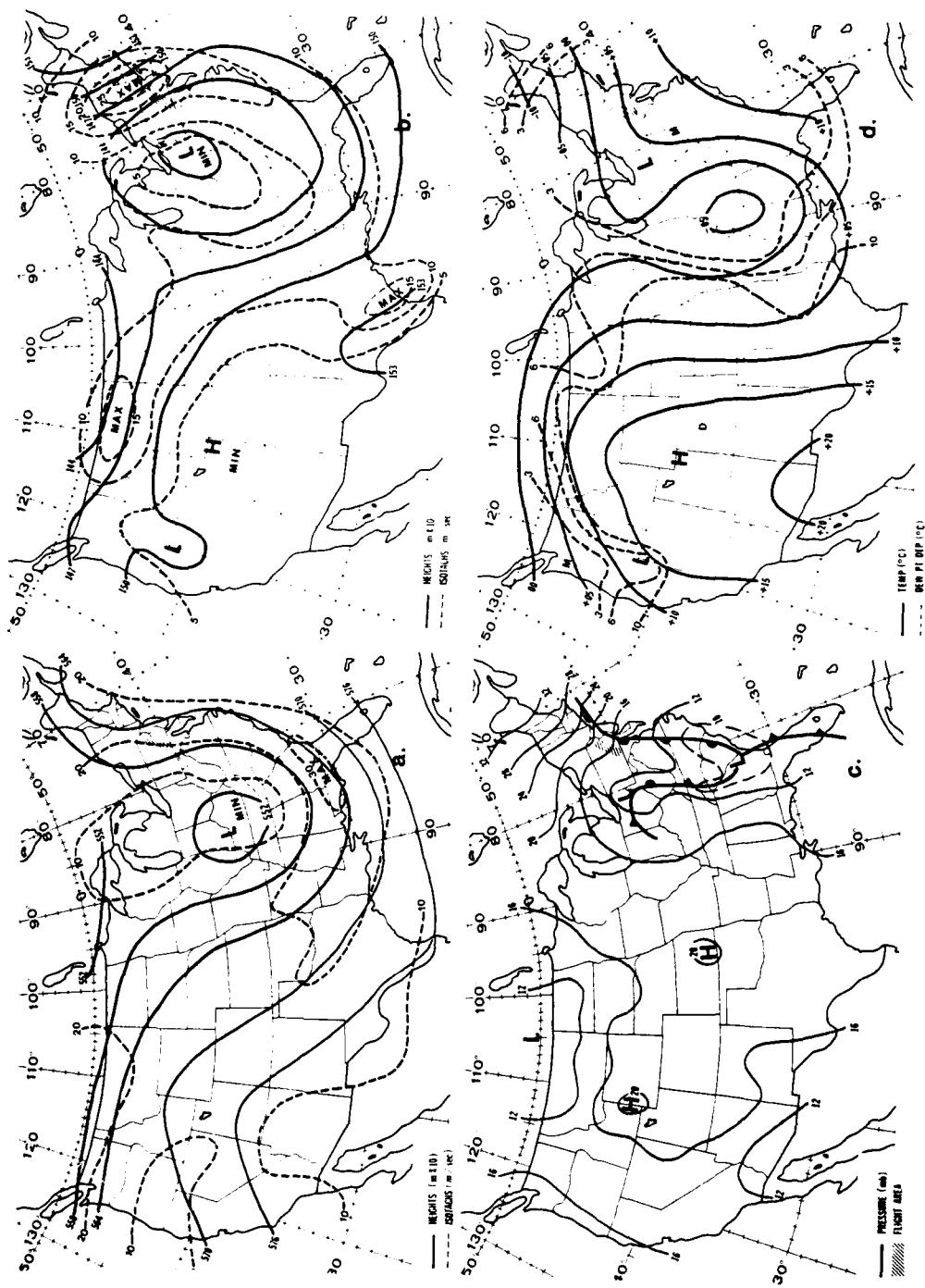
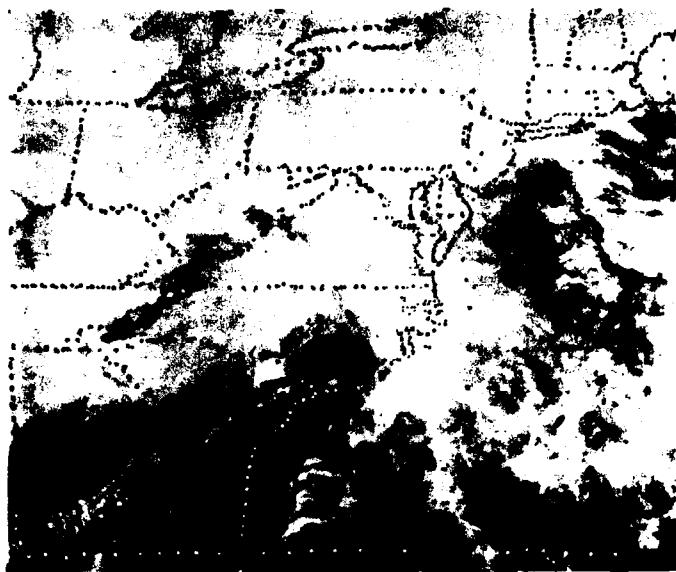


Figure 8. Synoptic Maps for 27 March 1978 at 0000Z. Charts show: (a) 500-mb heights and isotachs, (b) 850-mb heights and isotachs, (c) surface fronts and pressure patterns, (d) 850-mb temperature and moisture

a.



b.

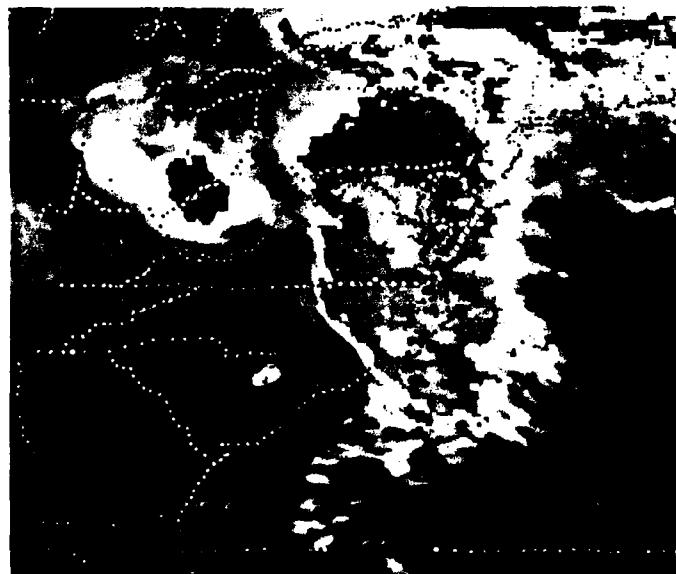


Figure 9. GOES East Satellite Photographs for 26 March.
(a) visible at 1930Z, (b) infrared at 1900Z

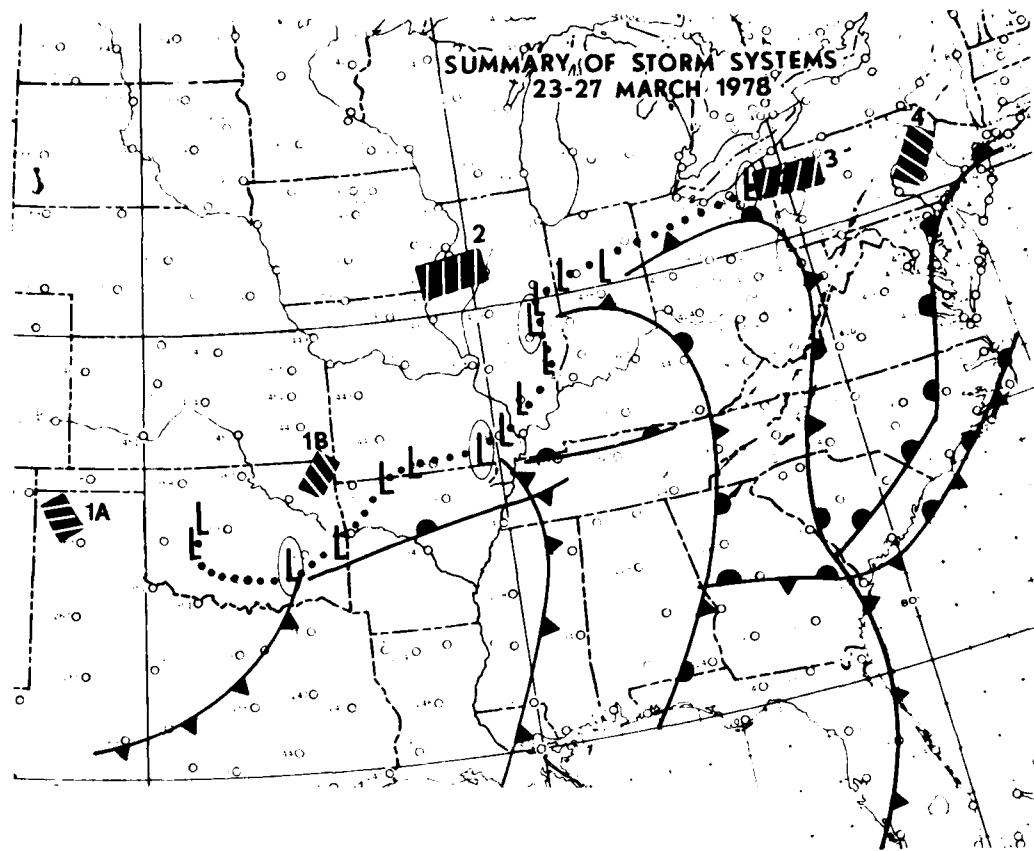


Figure 10. Track of the Main Low Pressure Area and Frontal Systems From 23 to 27 March. Frontal positions are those at 00Z on 24, 25, 26, and 27 March. The full extent of the fronts can be found on Figures 2, 4, 6, and 8. The position of the low center is shown for 6-hr intervals beginning at 12Z on 23 March. Positions of the low center which correspond to those of the frontal systems are circled. The dotted line show the track of the low. Shaded areas indicate the sampling locations.

3. THE FLIGHTS

On each of the four days, the MC-130E departed during the morning. It flew to a predetermined area north of the storm system and obtained data first at approximately 23,000 ft (7.0 km—the 400-mb surface) than at 18,000 ft (5.5 km), 10,000 ft (3.0 km), and 4,700 ft (1.5 km); the 500-, 700-, and 850-mb surfaces. Figure 10 shows these areas and the track of the main low center. On 23 March, passes at the first three levels were flown in north Texas (in the northwestern sector of the storm) before the complete pattern was flown in northeastern Oklahoma (in the

northeastern sector of the storm). The aircraft landed late in the afternoon of each day thus providing data during the period of maximum solar heating. Thus the four flights provide us with a profile of the storm from its development through its dissipation. A flight was planned for 27 March but by that time the storm had dissipated to such an extent that a flight would not have provided a significant increase in data. Table 1 provides information on the time and location of each flight.

3.1 Flight 78-10

On 23 March, the storm system consisted of a small low center in Oklahoma. The MC-130E departed from Kirtland AFB, Albuquerque, New Mexico. It first flew passes at 400, 500, and 700 mb in northern Texas. These passes were flown northwest of the center of the storm, since evidence from McIDAS showed extensive and deep cloudiness in this quadrant of the storm and the opportunity to sample two quadrants of the storm on the same day. In the northwest quadrant, the activity was mostly of a convective nature and as a result liquid water content varied drastically within each of the three passes. 2-D data showed an unusually high number of large particles, especially at 500 millibars. After completing these passes, the aircraft flew (at 23,000 ft/7.0 km) to northeastern Oklahoma, where four passes were flown, one each at 400, 500, 700, and 850 millibars. This area was in the northeast quadrant of the developing storm.

During the trip from northwest Texas to northeastern Oklahoma, the aircraft passed through some clouds but remained above most of the activity. Upon arriving at the sampling area, however, the aircraft was in uniformly gray clouds from 23,000 ft to 5000 ft (7.0 to 1.5 km). As a result, the liquid water recorded was generally high at all levels. After completing these passes, the airplane landed at Little Rock AFB, Arkansas.

3.2 Flight 78-11

By 1800Z on 24 March, with the low pressure center in northern Arkansas and a deepening open wave, the MC-130E departed from Little Rock AFB at 1746Z and proceeded to an area in eastern Iowa and northern Illinois about 200 nm north of the center. The strong low pressure areas at the surface and 850-mb levels drew considerable moisture into the system. The result was extensive cloudiness. Enroute to the sampling area, the aircraft, flying at 23,000 ft (7.0 km), was above a solid undercast which frequently reached the aircraft's altitude. Four passes were completed, one each at 400, 500, 700, and 850 millibars. Except for a few brief breaks, the aircraft was in cloudiness throughout this period. Liquid water content values were very high. The Mission Director frequently reported large, wet snowflakes. At 700 and 850 mb rain was often mixed with the snow. Conglomorate

snowflakes as large as 5000μ were observed at these levels. During this period, heavy snow forecasts were issued for much of Illinois and Indiana. The MC-130E flew from its sampling area to Wright-Patterson AFB, Ohio. Enroute, it was above a continuous overcast. It landed at Wright-Patterson AFB at 2340Z.

3.3 Flight 78-12

On 25 March, the low pressure center had moved to southern Illinois with an occluded front extending to eastern Tennessee. The MC-130E flew to an area in eastern Ohio and western Pennsylvania, about 350 nm northeast of the low. By this time, extensive low stratiform cloudiness covered all of the northeast except eastern New England. The MC-130E left Wright Patterson AFB, Ohio at 1705Z. It crossed central Ohio at 23,000 ft (7,0 km). At this altitude, it was between an altostratus layer (with tops estimated at 14,000 ft/4.3 km) and a cirrus layer (with bases estimated at 30,000 ft/9.1 km). The liquid water content observed at 400 and 500 mb was generally less than that observed during the previous day, indicating that while the system had become more widespread, it was not as intense. There was more moisture at 700 and 850 mb than there was on 24 March but not as much as had been observed on 23 March. The temperature in the lower 10,000 ft (3.0 km) changed little with altitude. Since the lower 3 km were generally near 0°C , the aircraft experienced considerable icing both at 700 mb and 850 mb. Most of the precipitation observed at these levels was either rain or snow mixed with rain. In general, precipitation intensity was much less than had been observed on earlier flights. The aircraft returned to Wright-Patterson AFB, and encountered the same type of enroute weather as it had while flying to the sampling area. The airplane landed at Wright-Patterson AFB at 2102Z.

3.4 Flight 78-13

On 26 March, secondary cyclogenesis pushed the warm air northward along the coast. The MC-130E left Wright-Patterson AFB at 1444Z and flew above the occlusion (which now ran from a low in Indiana through Ohio and south to a secondary low in Georgia; see Figures 6 and 8) to eastern Pennsylvania where the warm front from the secondary low was moving westward due to the circulation around the complex low system. The result was a uniform mass of stratiform clouds. Liquid water content was high throughout all of the sampling passes. During both the flight to the sampling area and the return, the airplane was at 23,000 ft (7.0 km). This put it above the lower clouds and most of the middle clouds. Cirrus clouds were above the airplane, however, during most of the deployment and return, the aircraft was not in visible clouds. The majority of the cloudiness was at 15,000 ft (4.6 km) and below. There was little vertical development—but stratus and stratocumulus

clouds covered all of the eastern United States north of Florida. Bases of the clouds in the sampling area were generally above the 850-mb level, although lower stratus clouds were observed while the aircraft was at the 850-mb level. The MC-130E returned to Wright-Patterson AFB and landed there at 1923Z. The storm system weakened after 0000Z on 27 March and no further flights were made.

4. VISUAL OBSERVATIONS OF THE CLOUDS

In addition to providing microphysical observations of this storm system, the inflight meteorologist (Mission Director) provided a visual account of the changes in the cloud structure as the storm progressed. The photographs used to illustrate this section of the report were taken by the Mission Director during the sampling flight.

4.1 Upper Levels

Figures 11, 12, 13, and 14 illustrate the changes in cloud appearance at 23,000 ft (7.0 km). All pictures were taken at that altitude, either while enroute to the storm area or during the first data pass in the area. As Figure 11 shows, there was considerable convective activity on 23 March. By 24 March (Figure 12) the number of convective cells was no longer as great, but the undercast had a wavelike appearance which strongly suggested convective cells completely embedded in the clouds below. During the next two days, the clouds became more uniform and convective activity became weaker and less organized. As Figure 13 shows, the structure had weakened, and by 26 March (Figure 14) there was little structure remaining. The amount of cloud at 23,000 ft (7.0 km), however, had increased but instead of the wavelike clouds shown in Figure 12 they were uniform gray in appearance.



Figure 11. Clouds From 23,000 ft (7,1 km) on 23 March 1978. Distinct convective activity can be seen in the center of the picture



Figure 12. Clouds From 23,000 ft (7,1 km) on 24 March 1978. While some convective activity was present, there were no distinct cells

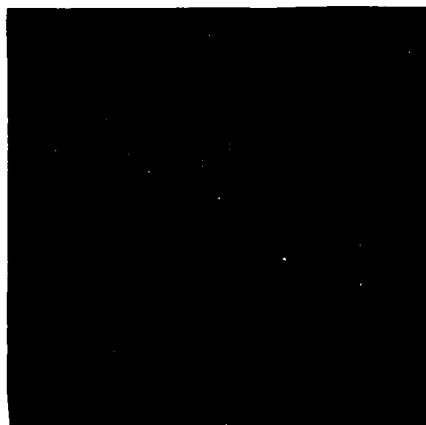


Figure 13. Clouds From 23,000 ft (7,1 km) on 25 March 1978. The system was occluded and stratified clouds prevailed



Figure 14. Clouds From 23,000 ft (7,1 km) on 26 March 1978. Almost no convective activity was found in this part of the system

4.2 Lower Levels

Figures 15, 16, 17, and 18 show how the cloud structure at lower levels appeared. Figure 15 was taken at 10,000 ft during the third data pass on 23 March. At this time, the aircraft was flying through small snow crystals which had fallen from the cloud deck above. No pictures were taken at 5000 ft (1.5 km) since the aircraft was continuously in clouds. On 24 March, the aircraft was continuously in clouds while sampling at 10,000 and 5000 ft (3.0 and 1.5 km). As Figure 16 shows, there was considerable rime icing at 10,000 ft (3.0 km). The outside air temperature was near 0°C and precipitation frequently changed from snow to rain. The same conditions were reported during the aircraft's 5000-ft (1.5 km) sampling pass. On 25 March, conditions at 10,000 ft (3.0 km) were similar, but at 5000 ft (1.5 km), there was much less cloudiness. As Figure 17 shows, the ground was visible from 5000 ft (1.5 km). On 26 March, there was an increase in cloudiness and precipitation at 5000 ft (1.5 km), but as Figure 18 shows, the ground was still visible through breaks in the clouds. The system had more moisture, but most of the additional moisture was reflected in the increase of upper and middle level clouds.,,

5. DATA PROFILES FOR EACH FLIGHT

5.1 23 March 1978

Figure 19 shows the altitude, temperature, liquid water content (LWC), medium volume diameter (DO), reflectivity (Z), number density (NT), and Form Factor (FF) as functions of time for the flight of 23 March 1978. The Form Factor is a method of characterizing distributions. It is more fully described by Varley⁵ and in Section 6.3 of this report. The heavy solid lines in Figure 19 indicate data passes. During the first three passes, with the airplane in a convective area, all of these quantities fluctuated quite rapidly. During the later passes taken in the northeast quadrant of the storm, LWC, DO, and Z all increased in magnitude; all reaching unusually high levels. The number density, however, tended to decrease as the aircraft descended. This we attribute to aggregation as the particles combined to form larger particles. The contrast in the Form Factor was most dramatic. During the first series of passes, it fluctuated rapidly from 0 to 1 while during the later passes it was more consistent; generally showing values of 0.20 to 0.30. Further discussion of the variations in the Form Factor and liquid water content will be found in Section 6 of this report.



Figure 15. Clouds From 10,000 ft (3.0 km) on 23 March 1978. Low level clouds presented a uniform gray appearance

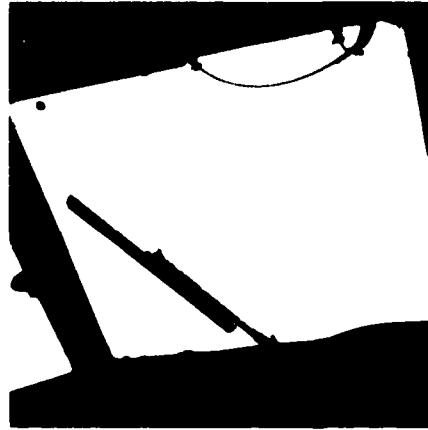


Figure 16. Clouds From 10,000 ft (3.0 km) on 24 March 1978. No structure was visible at this level. Note the icing on the wiper

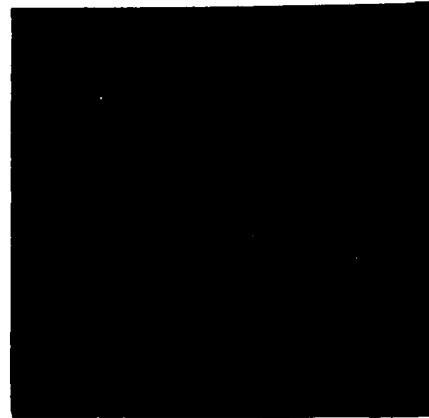


Figure 17. Clouds From 5000 ft (1.5 km) on 25 March 1978. The ground can be seen through low clouds



Figure 18. Clouds From 5000 ft (1.5 km) on 26 March 1978. During most of this pass the airplane was in rain. The ground could usually be seen below the fractocumulus layer

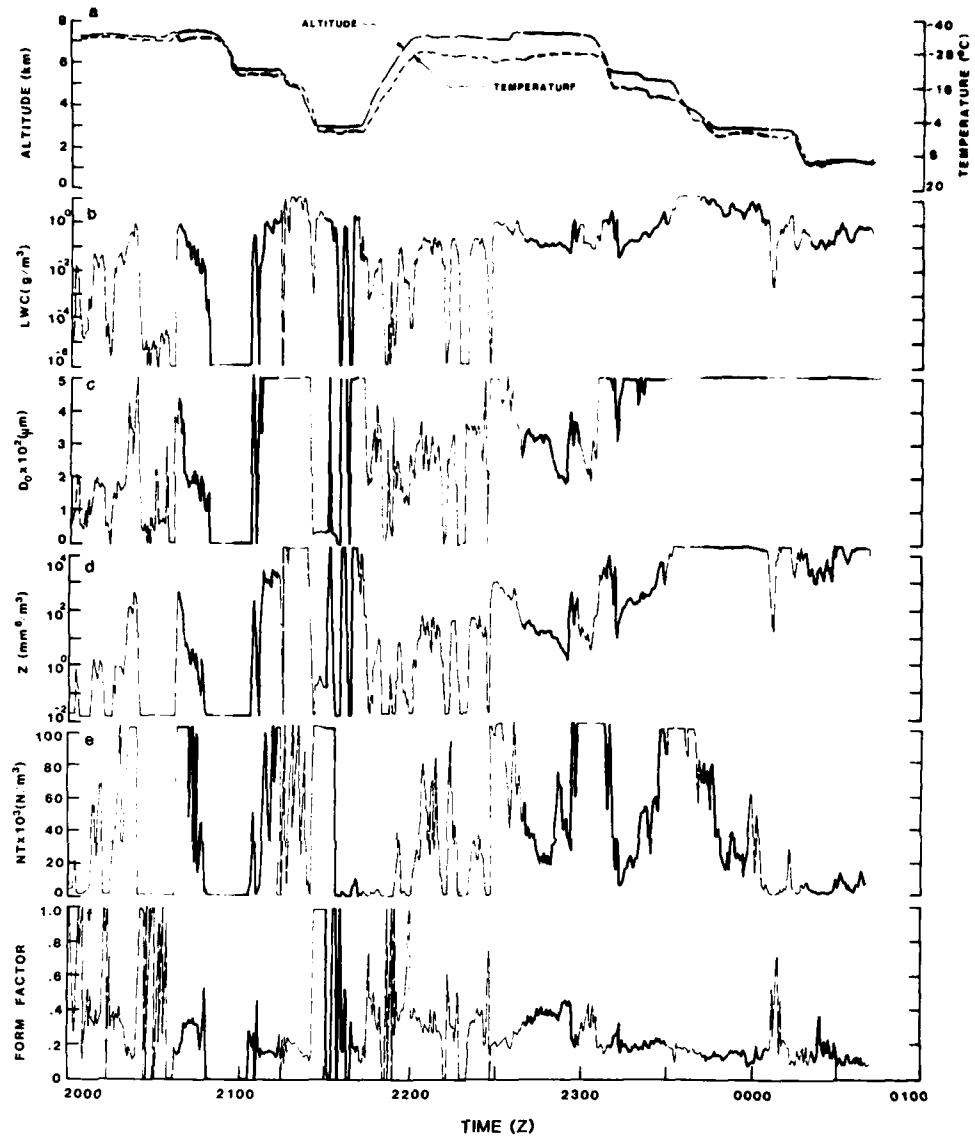


Figure 19. Profiles of (a) Altitude and Temperature, (b) Liquid Water Content, (c) Medium Volume Diameter, (d) Reflectivity, (e) Density, and (f) Form Factor With Time for the Flight of 23 March. Solid lines show when the aircraft was in a data pass

5.2 24 March 1978

Figure 20 shows the altitude, temperature, LWC, DO, Z, NT, and FF vs time for the 24 March flight. LWC values of 10^{-2} to 10^{-1} g/m^{-3} predominated. The reflectivity, however, did show a sharp increase in the lower levels. The high LWC values were reflected in high DO values but low NT values, thus a comparatively

small number of larger particles were producing the high LWC values. The Form Factor showed a decrease at the lower altitudes. There was a decrease in the variation of FF with time during the passes at lower altitudes but it was not as pronounced as it was during the flight of 23 March.

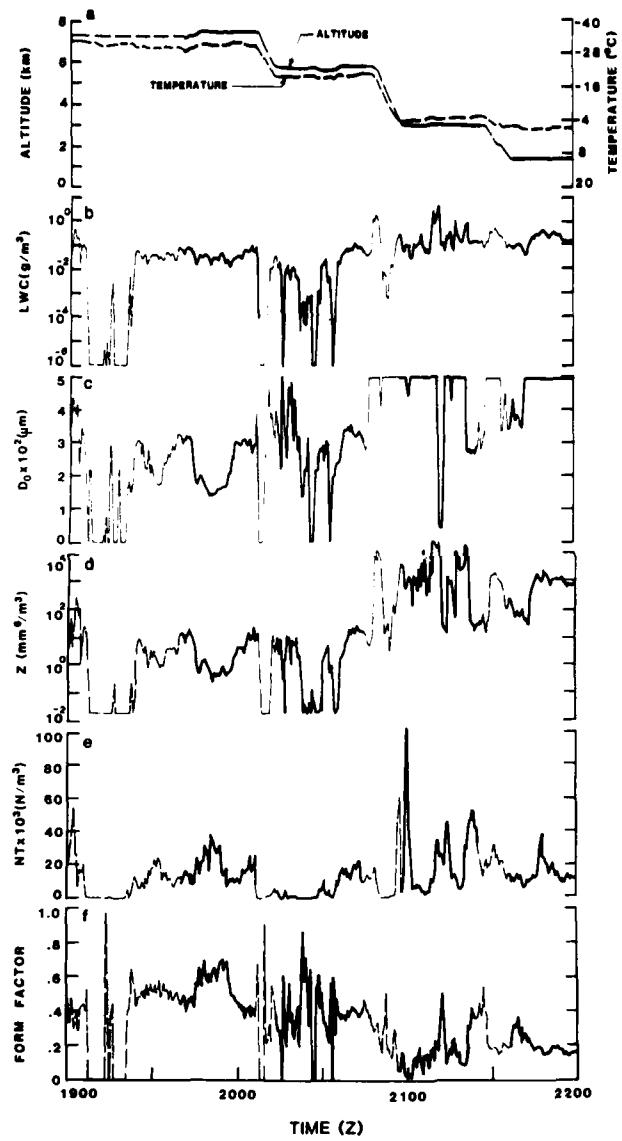


Figure 20. Profiles of
 (a) Altitude and Temperature,
 (b) Liquid Water Content,
 (c) Medium Volume Diameter,
 (d) Reflectivity, (e) Density,
 and (f) Form Factor With
 Time for the Flight of
 24 March. Solid lines show
 when the aircraft was in a
 data pass

5.3 25 March 1978

Figure 21 shows the same variables as Figures 19 and 20 for the flight of 25 March. The storm was weaker at this time, and in general the LWC was lower. Both Z and NT values were smaller, especially at the higher levels. As was mentioned in Section 4, the amount of cloudiness was smaller and the system was less well organized on 25 March. The medium volume diameter (DO) remained high, especially at lower levels, while the particle density was generally lower. Thus the decrease in LWC was more closely related to the smaller number of particles than to their smaller size. This was reflected in the lighter intensity of the precipitation reported by surface weather stations, as noted in Section 3. The Form Factor was more erratic, being generally higher at 400, 500, and 850 mb and lower at 700 millibars. The low Form Factor may have been the result of a frontal inversion at that level. The higher Form Factors at the higher levels may have indicated that there was less upward vertical motion that kept larger particles and the moisture needed to allow smaller particles to grow at lower levels. The 850-mb pass was in the melting layer, and as a result, a larger variety of particle sizes pushed up the Form Factor.

5.4 26 March 1978

Figure 22 shows these variables for the 26 March flight. The influx of warm air was reflected both by the warmer temperatures at 850 mb and the increase in LWC as compared to the data obtained on the previous day. The increase in LWC was a result of particle size as opposed to the number of particles. The values of DO were high throughout the flight. The high LWC, especially at lower levels, led to high values of reflectivity. The influx of warm moist air caused by the secondary low, which had formed in Georgia, led to an increase of large snowflakes and raindrops. The low values of the Form Factor at lower levels indicate a large variety of sizes, resulting partially from the influx of warm, moist air, and partially from aggregation. The amount of cloudiness increased and the intensity of the precipitation produced by the storm also increased. This occurred despite the fact that the main low itself was weakening.

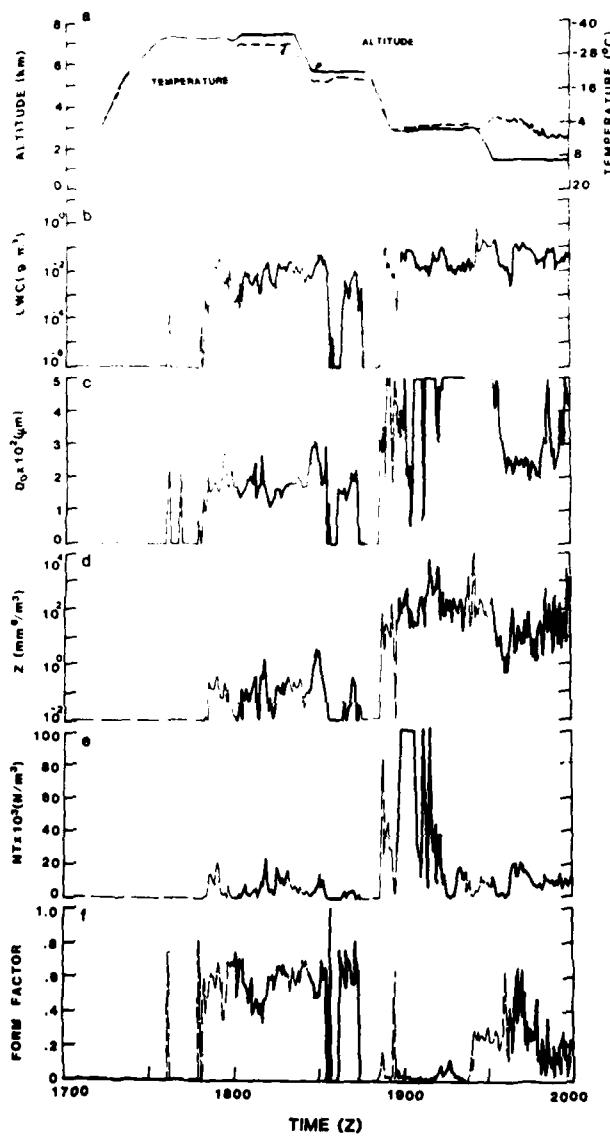


Figure 21. Profiles of (a) Altitude and Temperature, (b) Liquid Water Content, (c) Medium Volume Diameter, (d) Reflectivity, (e) Density, and (f) Form Factor With Time for the Flight of 25 March. Solid lines show when the aircraft was in a data pass

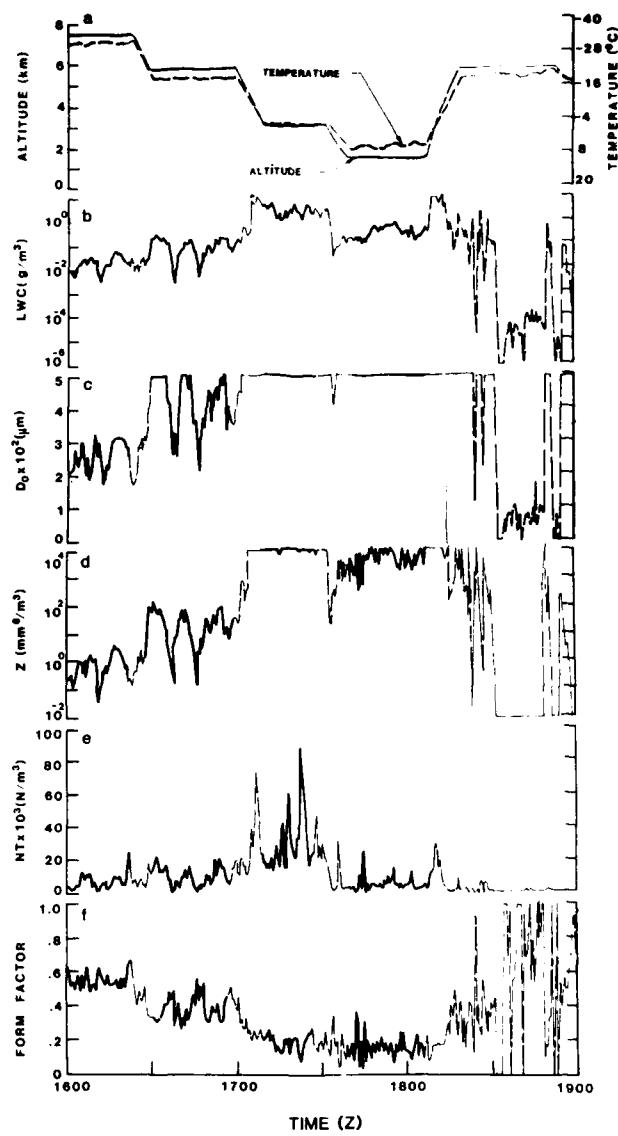


Figure 22. Profiles of (a) Altitude and Temperature, (b) Liquid Water Content, (c) Medium Volume Diameter, (d) Reflectivity, (e) Density, and (f) Form Factor With Time for the Flight of 26 March. Solid lines show when the aircraft was in a data pass

6. DISCUSSION OF DATA

The previous section looked at the measurements obtained by each flight as a separate though related unit. This Section will concern itself with an examination of how various data changed at each of the four levels investigated.

6.1 Crystal Types Encountered

The Mission Director made in-flight observations of the predominating crystal habit. His comments are included in the transcripts in Appendix A. These observations provided input to the real-time 1-D data reduction programs, which provide LWC and Z values, and for post flight backup in case of the loss of 2-D data. The snow stick, the 2-D display, and visual observations of hydrometeors passing by and hitting the aircraft helped him determine the crystal habit.

The PMS 2-D system was operational on all data passes. Table 2 shows the predominant crystal types recorded by the 2-D system. At the 400-mb level, the predominant crystal type was small snow, although at times bullet rosettes were common. At 500 mb, large snow occurred when the system was more active. During less active periods, small snow predominated. At the lower levels, rain, needles, wet snow, and large snow occurred, as the temperature was generally near freezing.

The crystal types, as indicated in Table 2, were used to prepare 1-D PMS data for this report.

Table 2. Particle Types Encountered During Different Passes on the Flights of 23 to 27 March 1978

Altitude	23 March (Texas)	23 March (Oklahoma)	24 March (Iowa, Illinois)	25 March (Ohio Pennsylvania)	26 March (Pennsylvania)
23,000 ft	Small Snow Bullet Rosettes	Small Snow	Small Snow	Small Snow	Small Snow
18,000 ft	Large Snow	Large Snow	Large Snow Small Snow	Small Snow Bullet Rosettes	Large Snow Small Snow
10,000 ft	Wet Snow	Wet Snow Rain	Rain, Wet Snow Needles Large Snow	Rain	Wet Snow
5,000 ft		Rain	Large Snow	Large Snow	Rain

Figure 23 shows some typical 2-D shadowgraphs observed during each of the nineteen data passes taken during these missions. In most cases data from both the cloud probe and precip probe are included. Data from the precip probe are indicated by the letter "P". The height of the vertical lines on these samples represents a distance of 6400 μm . Data from the cloud probe are indicated by the letter "C". On these samples, the vertical lines represent 800 μm . The samples have been assembled to show the changes with height and time of the crystals and droplets contained in the clouds.

Precipitation probe data from Pass I on 25 March are excluded due to the lack of larger crystals during this pass. During Pass III on that same day, water lodged in the precip probe obscured most of the precip probe data. Therefore precip probe data from Passes I and III are excluded.

Additional 2-D shadowgraphs are presented later in this report.

The snow stick can provide detailed observations of snow and ice crystals. A 1-cm square area marked on a black background with millimeter graduations is mounted on an aluminum rod. This rod is passed through a hole in the aircraft skin so that the exposed surface is parallel to the airflow. The Mission Director observes the particles from the flight deck window at a distance of about 3 feet. Since there are four graduated surfaces, a fresh surface may be obtained by rotating the snow stick.

Postflight crystal habit determinations using 2-D data were used for the flights since they provide a continuous objective source. Snow stick observations augmented the 2-D data. Other Mission Director comments and data from the Johnson-Williams instrument were used to help detect supercooled water and the presence of rain in snow.

6.2 Particle Size Distributions

Marshall and Palmer⁷ observe that raindrop size distributions approximate an exponential curve. Most observations of snowflake sizes also approximate an exponential curve. The distributions observed at various altitudes for the four flights being considered are presented in Figure 24. Houze et al⁸ have considered departures from this exponential curve and describe an enhanced distribution as having an increase of smaller particles (30 to 500 μm) above an exponential curve, while a suppressed distribution has a decrease below the curve. Houze's study disregarded

7. Marshall, J.S., and Palmer, W. Mck (1948) The distribution of raindrops with size, *J. Meteor.*, 5:165-166.

8. Houze, R.A., Hobbs, P.V., Herzegh, P.H., and Parsons, D.B. (1978) Airborne measurements of the size distributions of precipitation particles in frontal clouds, *Preprints of Conf. on Cld. Physics and Atmos. Elect.*, American Meteorological Society, Issaquah, WA, pp 168-172.



Figure 23. Typical 2-D Shadowgraph. Data from the Knollenberg 2-D system are presented for each pass. A letter "C" indicates a line of cloud probe data. Thus, the height of each line is 300 μm . A letter "P" indicates precip probe data, with the height of each line representing 6400 μm .

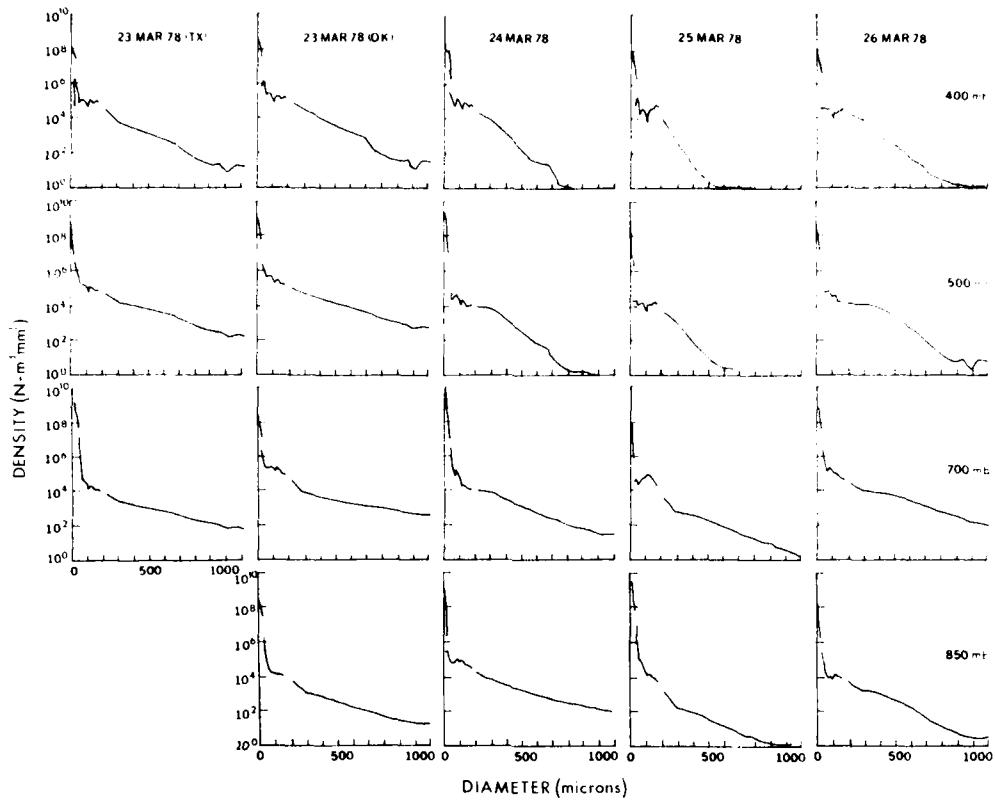


Figure 24. Distributions of Particle Density vs Particle Size (equivalent melted diameter) for Each Pass During the Sampling Flights

data from the ASSP (below 30 μm), probably because the ASSP tends to count all particles and thus overestimates the number of small particles whenever a large number of particles above 30 μm are present. Figure 24 shows the particle density vs diameter for each data pass observed during the four days. To insure uniformity, equivalent melted diameter was used as a measure of particle size. Although ASSP data are included in Figure 24, they should not be used when making comparisons to Houze's work. As Figure 24 shows, the storm had suppressed distributions at the higher levels, but had enhanced distributions at lower levels. Since Figure 24 used melted diameter rather than the measured diameter for particle size, departures from the exponential curve are most evident at a size range of 15 to 300 μm . Furthermore, the type of distribution varied more with altitude than it did with time. At lower levels, the enhanced distributions probably were the result of an increase in the number of large particles. The number of particles in

the 15 to 300 μm range showed little change. As Table 2 showed, rain and wet snow predominate there. The larger number of large particles gave the exponential curve a smaller slope. Thus, the same density of smaller particles that appeared as an enhanced distribution at low levels was part of a suppressed distribution at higher levels.

A few words of caution about the use of exponential curves as fits to these size distributions are in order. First, the fit is only for a limited region of the size distribution and has usually been applied to cases of moderate to heavy precipitation rates where the particles are fairly large, that is, in the hundreds of microns range. Second, the upper limit of the useable spectra (about 6 mm for rain and for snow) have been empirically determined by Plank, Berthel and Barnes⁹ and Berthel¹⁰ to be inversely related to the slope of the exponential. Third, a peak in the distribution in the 0.1 to 10 μm range is suspected due to the rapid growth of water molecule clusters below this size range. Fourth, in general, the longer the period of sampling and the larger the number of particles sampled, the closer the fit will be to an exponential curve. This is due to the small sampling volumes of the instruments and the separation of sizes by natural processes.

6.3 Form Factor

Plank¹¹ describes the Form Factor as a method of characterizing various types of particle distributions. The Form Factor is a measure of the uniformity of distribution of different sized particles. A Form Factor of 1.0 (the maximum) indicates that all particles in a given distribution fall in the same size range. This would represent a monodispersed distribution. Generally, the broader the spectrum of particle size, the lower the form factor will be. Figure 25 shows how the Form Factor at 400 mb changed with time. As the storm moved eastward, the cloud was more often a result of overrunning, thus producing a more homogeneous cloud. The top line of Figure 24 shows that the number of larger particles decreased from the 23rd to the 25th as the storm moved north and east. This led to a higher average Form Factor on the 24th and 25th as seen in Figure 25. This Form Factor at 500 mb (Figure 26) tends to be lower.

9. Plank, V.G., Berthel, R.O., and Barnes, A.A. (1980) An improved method for obtaining water content values of ice hydrometeors from aircraft and radar data, *J. Appl. Meteorology*, 19:1293-1299.
10. Berthel, R.O. (1980) A Method to Predict the Parameters of a Full Spectral Distribution From Instrumentally Truncated Data, ERP No. 689, AFGL-TR-80-0001, AD A085950.
11. Plank, V.G. (1977) Hydrometeor Data and Analytical-Theoretical Investigations Pertaining to the SAMS Rain Erosion Program of the 1972-1973 Season at Wallops Island, Virginia. AFGL/SAMS Report No. 5, ERP No. 603, AFGL-TR-77-0149, AD A051193.

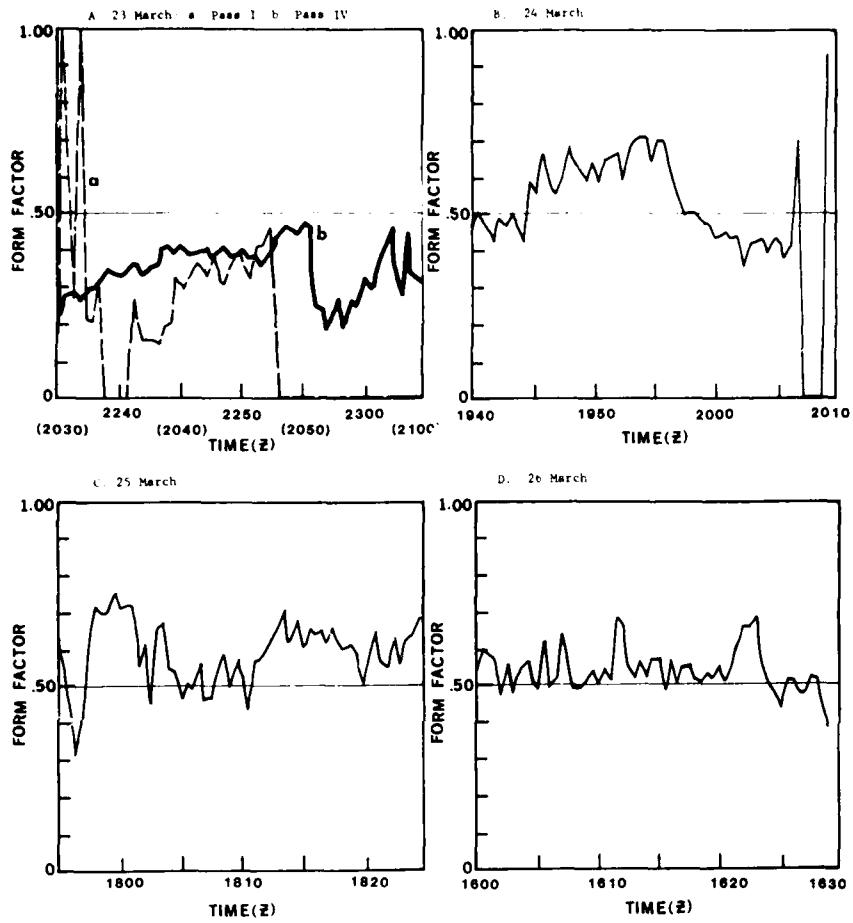


Figure 25. Form Factor at 400 mb for Each of the Four Days. Dotted line shows data from the first pass on 23 March. Times in parenthesis refer to that pass.

The predominance of larger particles (large snow as opposed to the small snow at 400 mb) and a flatter distribution leads to the lower Form Factors. At the lower levels, the Form Factor varies at a more rapid rate. Thus in this case, the particles at 400 mb tended to be more uniform in size than those at lower levels. The 700-mb data (Figure 27) are quite irregular as the changing conditions at that level caused a variety of particle types. This level was frequently near the freezing level. The 850-mb data (Figure 28) shows a high degree of variability. This can be attributed to the presence or lack of clouds and/or precipitation at that level. The difference between the third flight (during which the aircraft was in almost continuous

cloud at 850 mb) and the fourth (in which the aircraft was constantly going into and out of clouds and precipitation) is most striking.

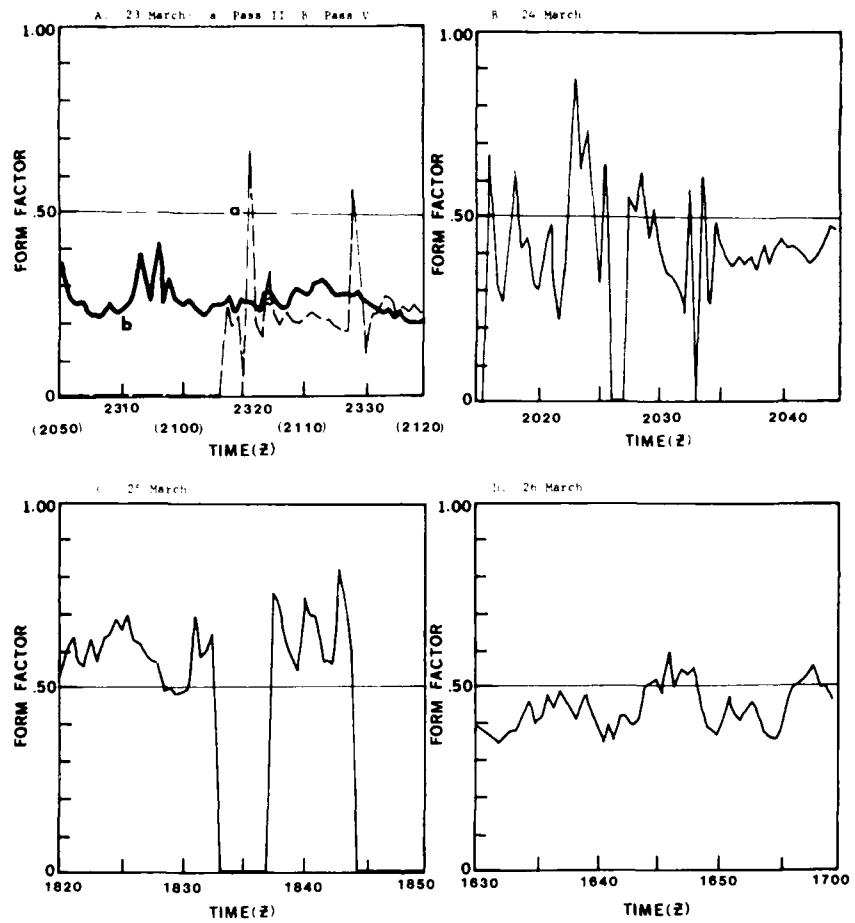


Figure 26. Form Factor at 500 mb for Each of the Four Days.
Dotted line shows data from the second pass on 23 March

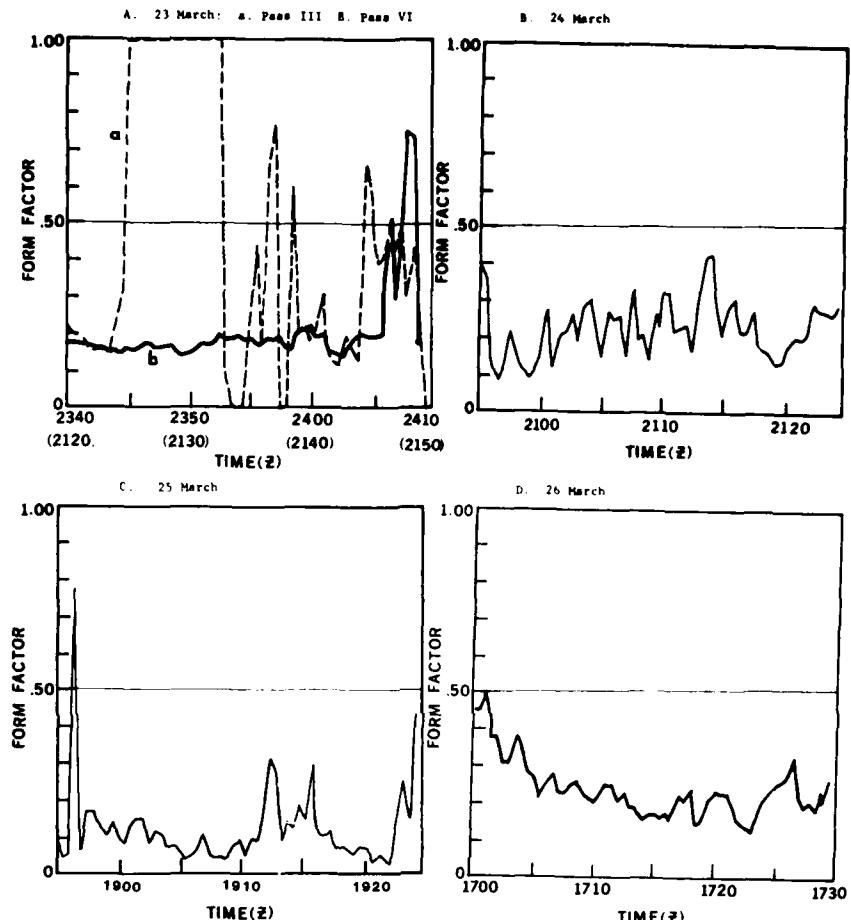


Figure 27. Form Factor at 700 mb for Each of the Four Days.
Dotted line shows data from the third pass on 23 March

6.4 Liquid Water Content

As a general rule, liquid water content values (LWC) throughout these four flights were higher than those found in the 1 to 3 March 1978 flights (see Varley⁵). At 400 mb, values of LWC of 10^{-1} g/m³ were common, and as Figure 29 shows, a value of 1 g/m³ was recorded during the first flight. Highest values of LWC at 400 mb were recorded during the first two days while the storm was feeding on warm, tropical air. Later, as the storm moved farther north, there was a decrease in the liquid water content at this level. A similar though less emphatic pattern emerged at 500 mb, as shown in Figure 30. Again, values as large as

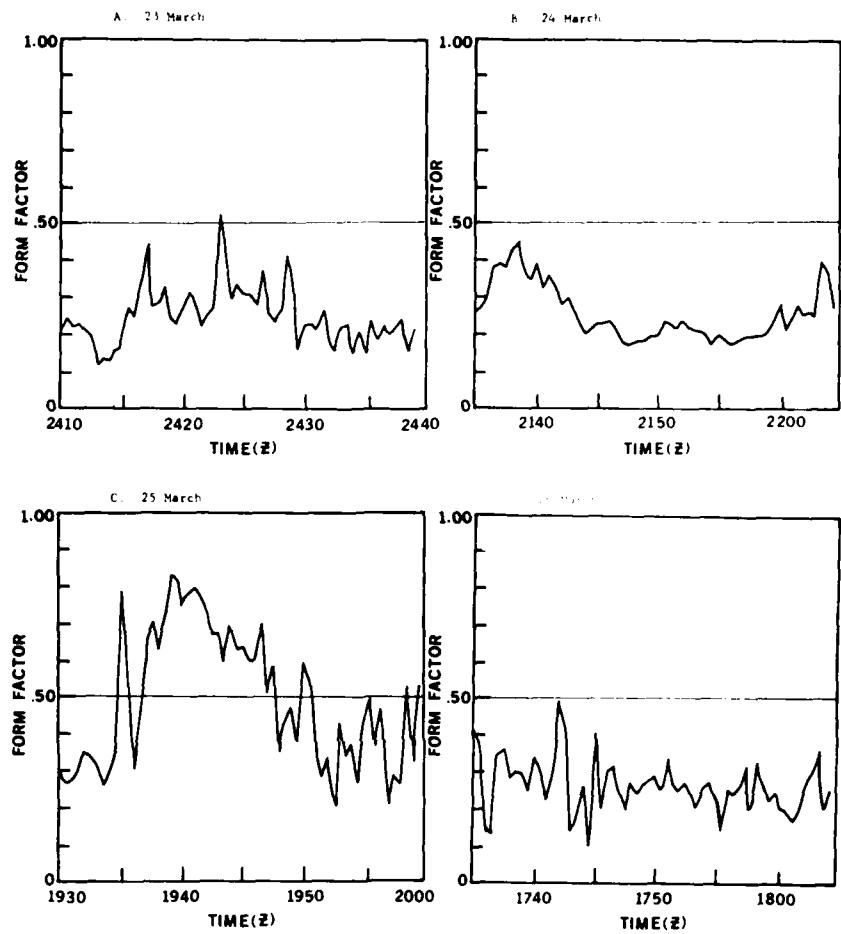


Figure 28. Form Factor at 850 mb for Each of the Four Days.
Dotted line shows data from the fourth pass on 23 March

1 g/m^3 were reported on the first flight, with values as high as 10^{-1} g/m^3 reported on other flights. The increase in 500-mb LWC on the final day may have been due to either a re-intensification of vertical motion in the storm or the proximity of the ocean. There was a similar increase in LWC at 400 mb, but it was much smaller than the increase at 500 millibars. Generally, the 500-mb LWC seemed less strongly affected by latitude and more strongly related to the strength of the storm and the proximity of a large body of water. The LWC at 700 mb seemed to follow this latter trend to an even greater extent. As Figure 31 shows, at this level the flight had high but irregular values of LWC. The next highest values were recorded

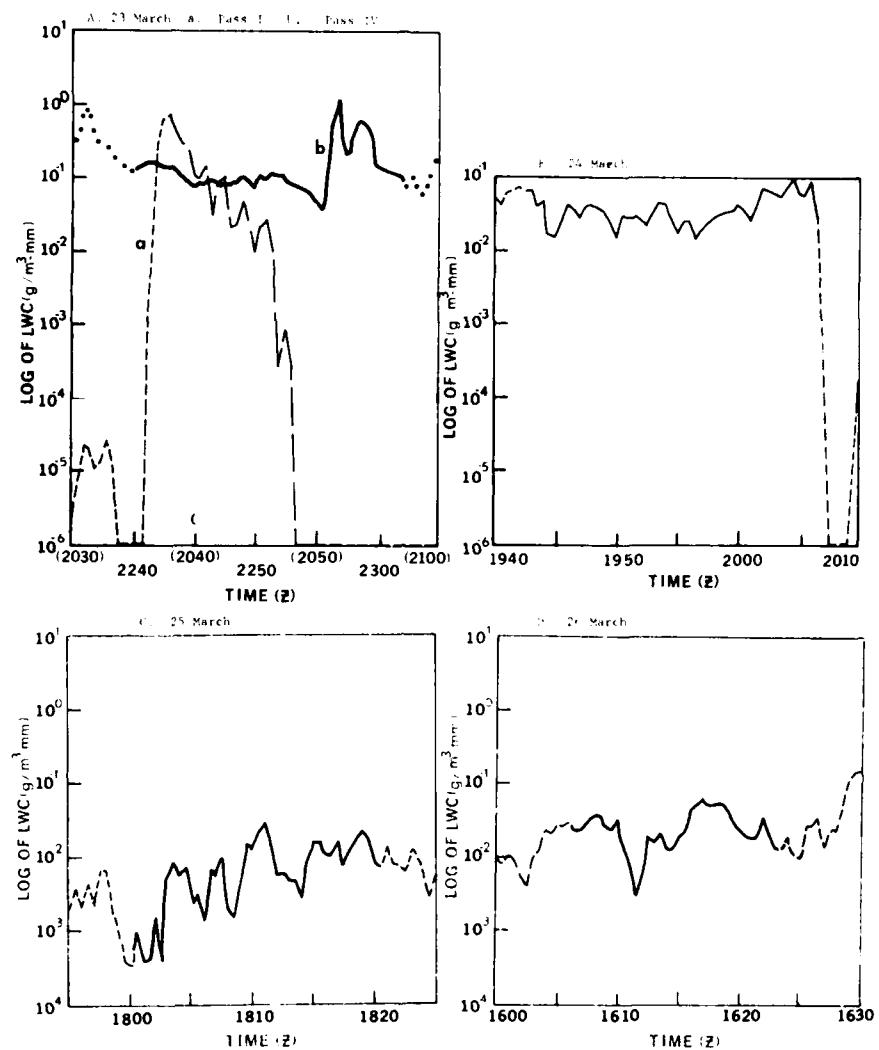


Figure 29. Liquid Water Content at 400 mb for Each of the Four Days.
Dotted line shows data from the first pass on 23 March

on the final flight, where LWC values were generally greater than 10^{-1} g/m³. Values this high were rare at this level on the second day and almost nonexistent on the third. The 850-mb LWC data, seen in Figure 32, shows the least variability, in contrast to the Form Factor at the same level (see Figure 28). Both within the flights and from flight to flight, the LWC values here are the most consistent. Generally at this level the airplane was in rain or water-droplet clouds. Thus,

while the particle distributions may have varied, the actual amount of water present in the atmosphere at the 850-mb level seemed less affected either by the geographic location of the storm or its state of development.

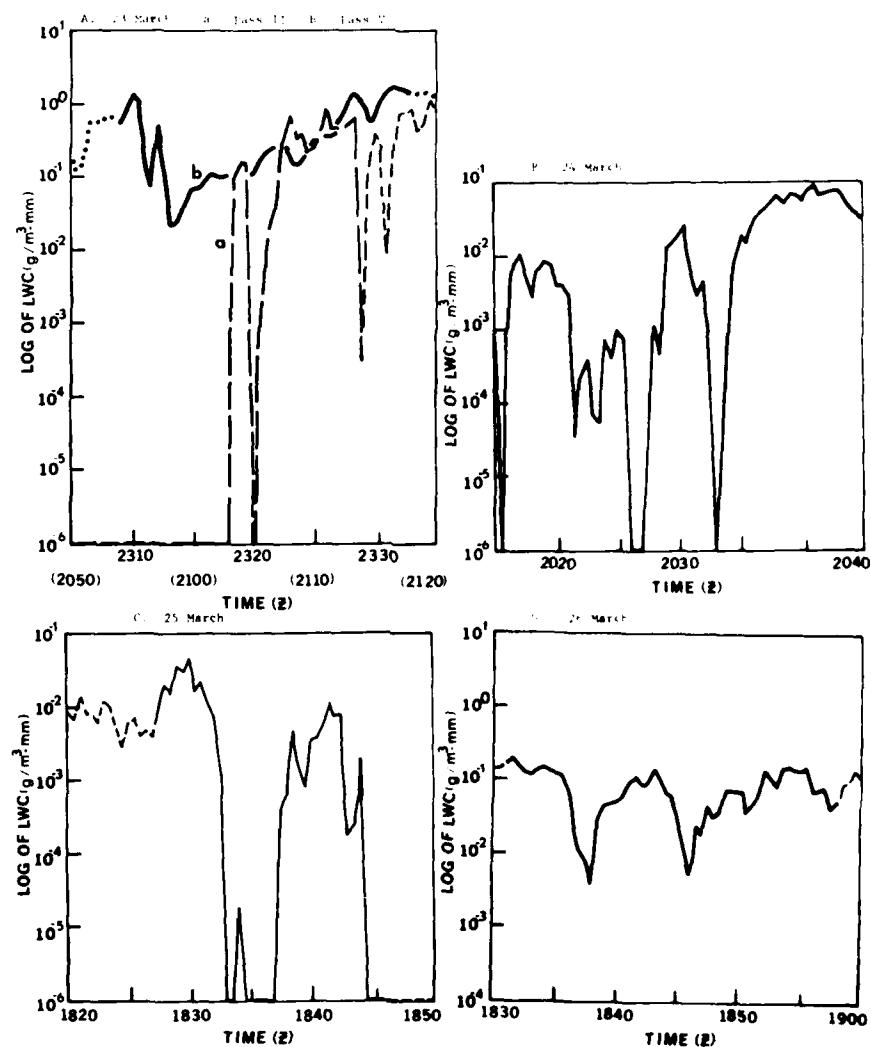


Figure 30. Liquid Water Content at 500 mb for Each of the Four Days.
Dotted line shows data from the second pass on 23 March

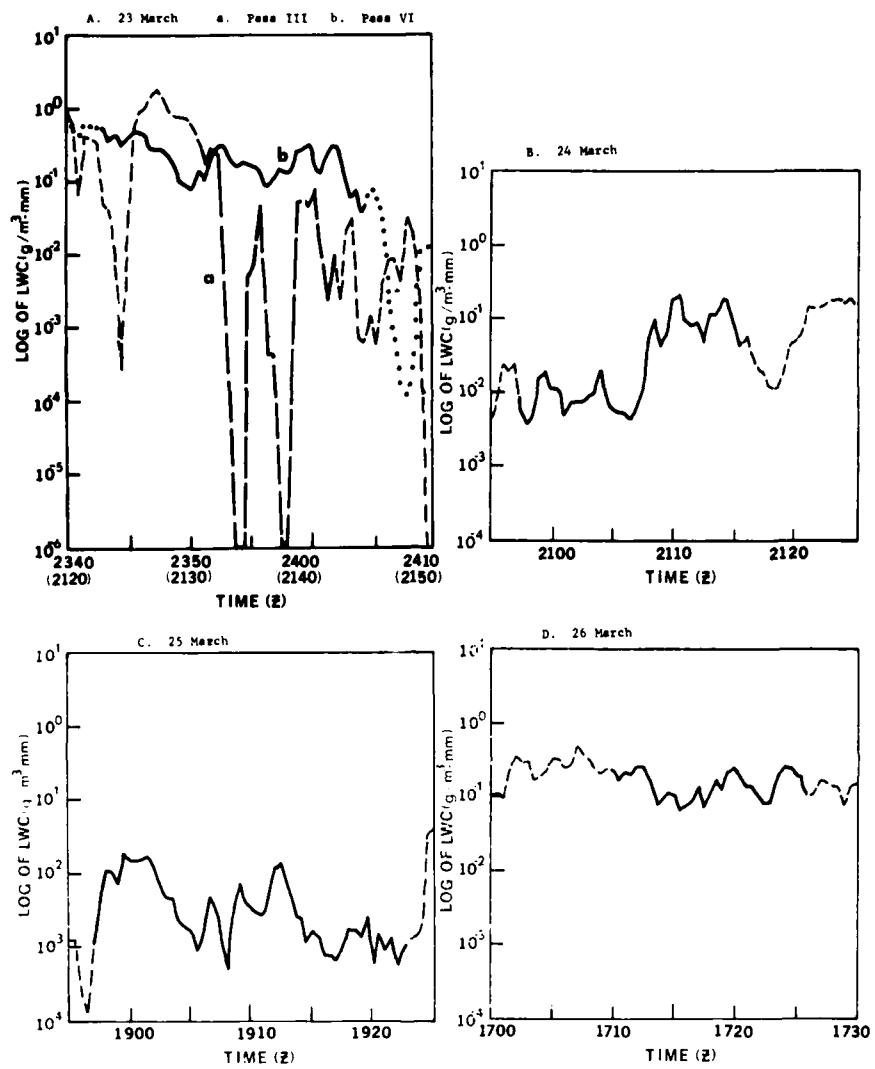


Figure 31. Liquid Water Content at 700 mb for Each of the Four Days.
Dotted line shows data from the third pass on 23 March

6.5 Particle Counts

The Particle Count (NT) is a limited measure of the number of ice or water particles per unit volume.

NT is calculated from data provided by the ASSP, the 1-D cloud probe, and the 1-D precip probe that adjust for the overlap of their measuring ranges. Particles larger than 6.4 mm and smaller than 2 μm are excluded since they are outside the

range of the instruments. The range of measurements is the same for most of our flights, including all of those described herein. Values of NT reported by different investigators may vary due to the specific instrumentation used. As seen in Figure 24 and commonly observed on most of our flights, NT is dominated by the number of small particles. Thus NT is very sensitive to the minimum size required for a particle to be sensed.

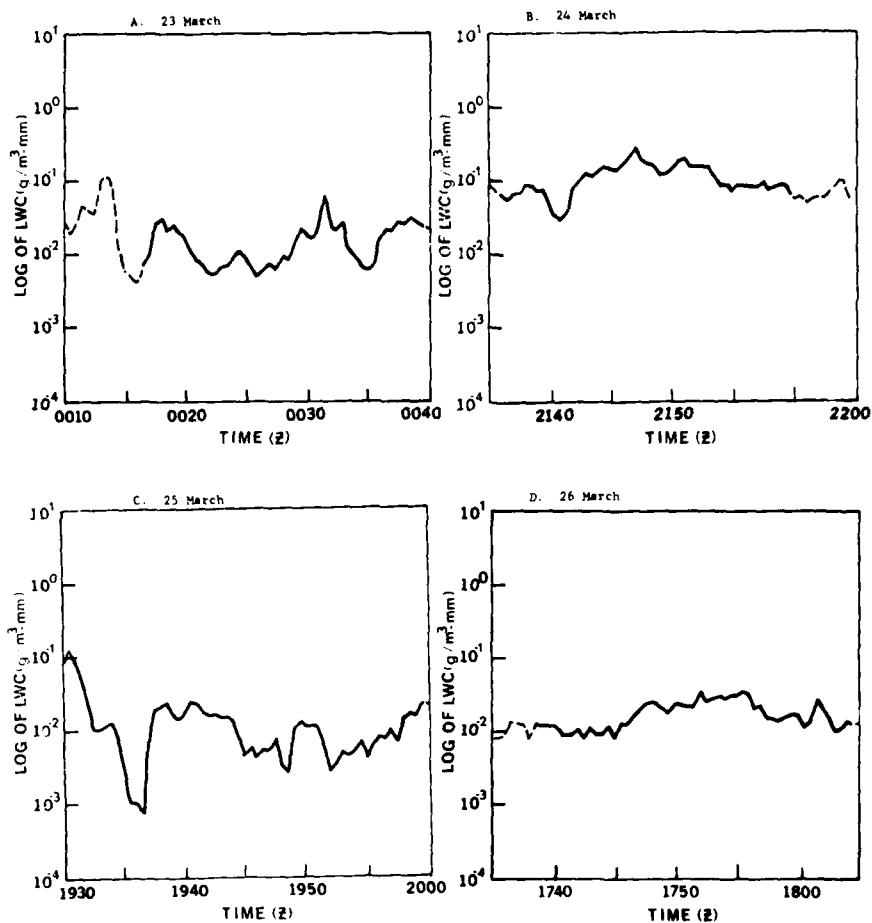


Figure 32. Liquid Water Content at 850 mb for Each of the Four Days.
Dotted line shows data from the fourth pass on 23 March

Byers¹² indicates that cumulus (convective) clouds will have a different particle size distribution from stratus clouds. Generally, the convective clouds will have large particles and a less consistent distribution of particles vs size. As a rule, observations on this flight showed that in convective clouds there were more particles at higher levels, while particle counts at lower levels were influenced less by the type of cloud.

Figure 33 shows NT for particles in the 2- to 6400- μm size range vs time for the passes at 400 millibars. The convective clouds on 23 March gave high but erratic values of NT. By 24 March, there were considerably fewer particles at this level. On the last two days, particle counts were considerably lower, since not only was the storm mostly stratiform, but there was less moisture at 23,000 feet.

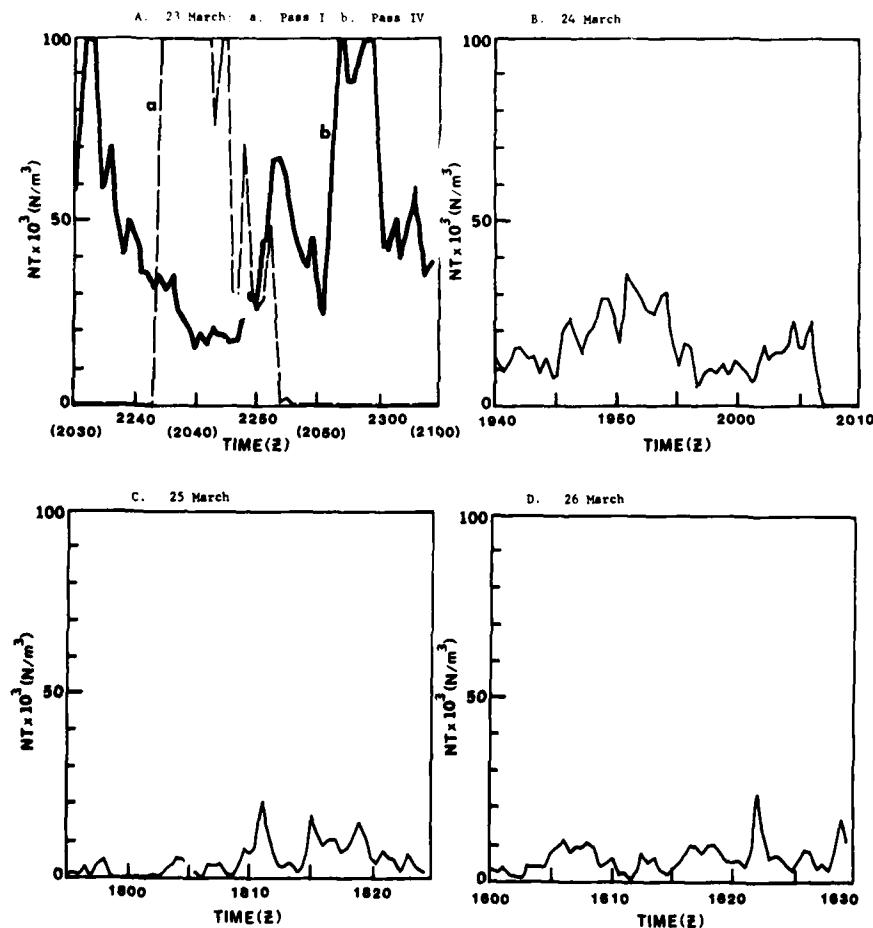


Figure 33. Particle Density (number of particles per cubic meter) at 400 mb for Each of the Four Days. Dotted line shows data from the first pass on 23 March

12. Byers, H. R. (1965) Elements of Cloud Physics, University of Chicago Press.

A similar trend appears at 500 mb as seen in Figure 34. As the system became more stratified, the values of NT decreased, although unlike the case at 400 mb the aircraft was in heavy cloudiness at 400 mb on all four days.

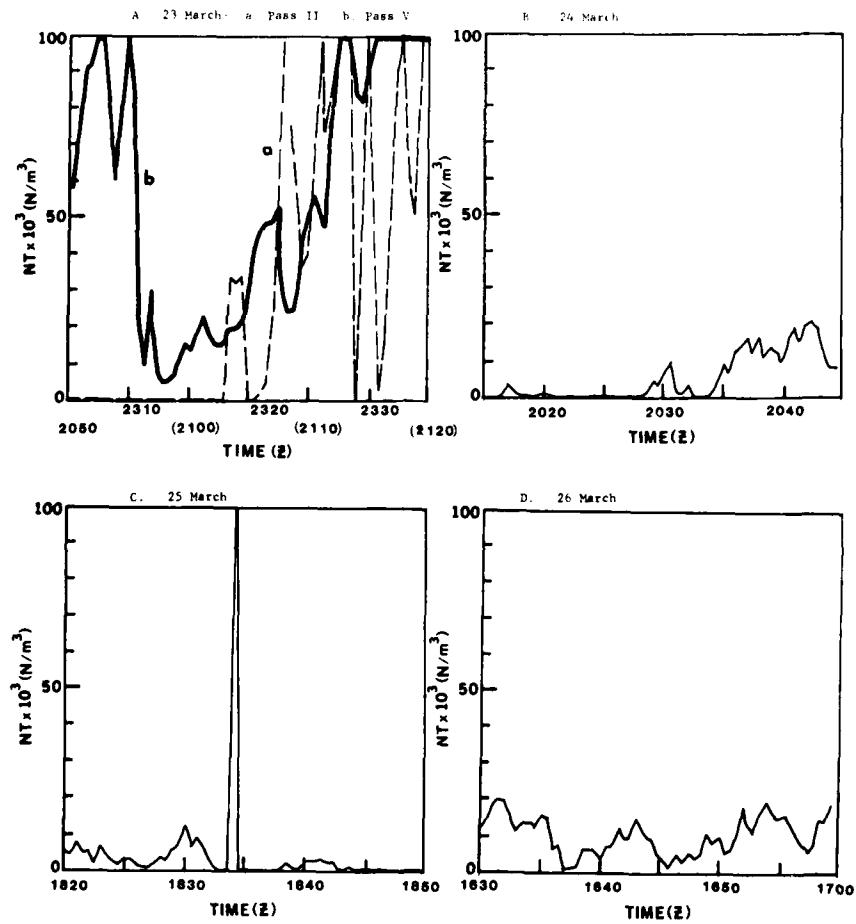


Figure 34. Particle Density (number of particles per cubic meter) at 500 mb for Each of the Four Days. Dotted line shows data from the second pass on 23 March

The particle counts at 700 mb showed a smaller change overall, although as Figure 35 shows, the values were more erratic on the first day. Despite the more stratified nature of the clouds on days 3 and 4, there were still some high values

of NT, several times reaching $5 \times 10^5 / m^3$, a value never approached during the passes at higher altitudes.

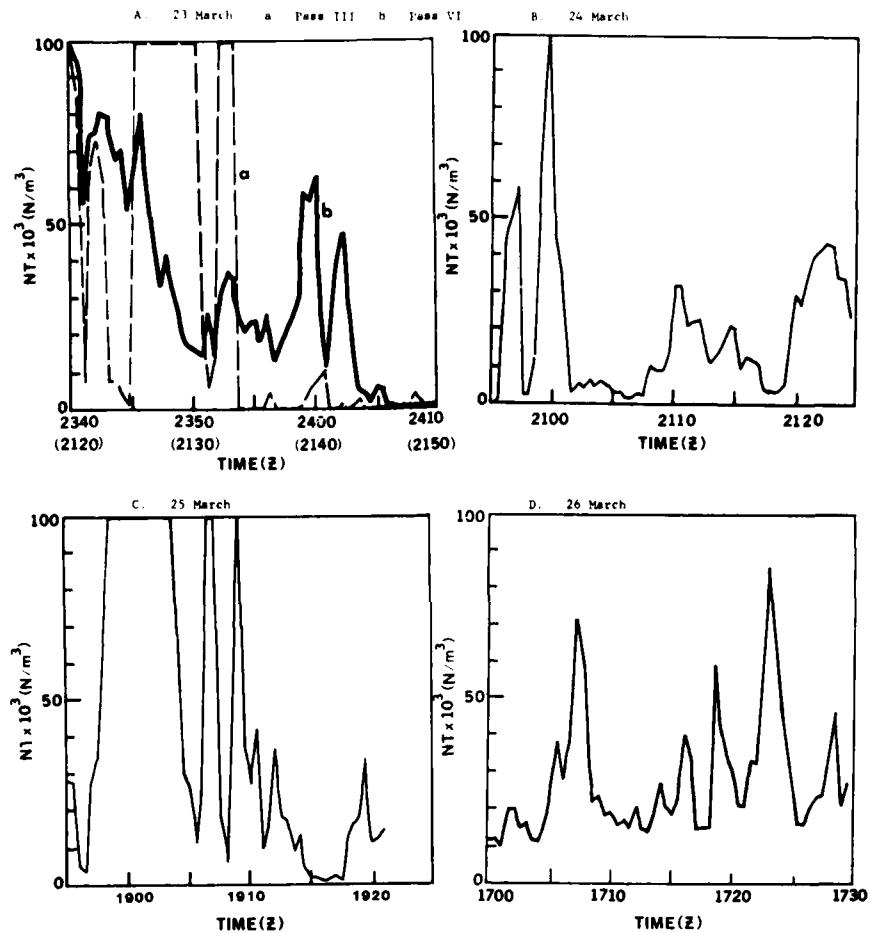


Figure 35. Particle Density (number of particles per cubic meter) at 850 mb for Each of the Four Days. Dotted line shows data from the fourth pass on 23 March

In general, NT values were smallest at 850 millibars. This can probably be attributed to smaller particles combining into larger particles (aggregation) between the 700-mb and 850-mb level. As Figure 36 shows, the particle distributions varied more within a given pass than they did from pass to pass. This is an indication of the variability of aggregation.

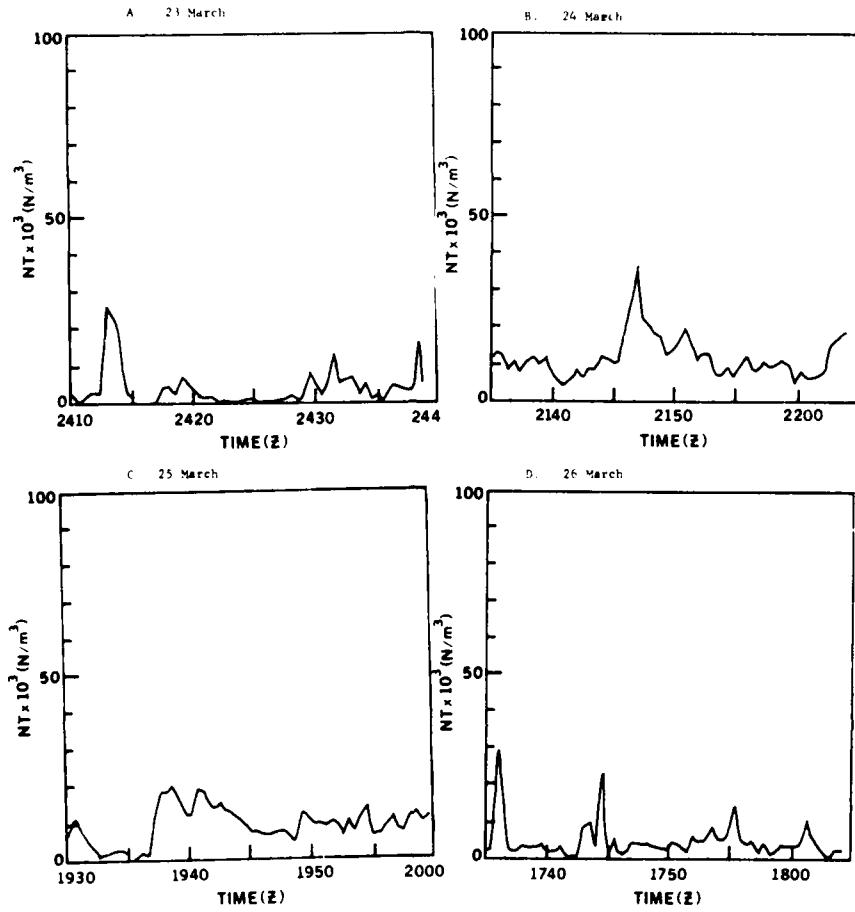


Figure 36. Particle Density (number of particles per cubic meter) at 850 mb for Each of the Four Days. Dotted line shows data from the fourth pass on 23 March

6.6 Other Data

Reflectivity (Z) and medium particle diameter (DO) can also be examined in this manner. As a rule the reflectivity seemed to follow the liquid water content. As can be seen in Figures 19 to 22, high values of Z usually correspond to high values of LWC. Dyer, Berthel, and Izumi¹³ have examined the relationship of Z to the

13. Dyer, R.M., Berthel, R.O., and Izumi, Y. (1981) Techniques for Measuring Liquid Water Content Along a Trajectory, ERP No. 233, AFGL-TR-81-0082, (in press).

mass of a particle. Their work used data taken at Wallops Island, Virginia and Kwajalein Atoll in the Marshall Islands.

The medium volume diameter tended to increase at lower altitudes. It followed similar patterns on all flights, with 700- and 850-mb values being higher than 400 and 500 millibars. This may be due to a reduced number of smaller drops resulting from either sublimation of these small drops or the coalescence of smaller drops into bigger ones. This agrees with the observation that NT is smaller at lower levels. Regardless of the type of cloud, there are fewer, but larger particles at the lower levels; another sign of aggregation.

7. OBSERVED TWO-MINUTE PARTICLE DISTRIBUTIONS

We can take a closer look at the LWC and particle size distributions by examining averages over 2-min periods. Two such periods have been selected for each altitude and each flight and are presented here with corresponding PMS 2-D data.

In addition to the PMS 2-D data and particle size distributions, the mean and standard deviations of 30-sec averages of temperature, altitude, liquid water content (LWC), reflectivity (Z), medium volume diameter (DO), number density (NT), and Form Factor (FF) are provided. The data for each 30-sec period are found in Appendix B, therefore, only the mean and standard deviations of the four 30-sec periods within each 2-min period are included here.

Periods were selected at times of consistent LWC and are intended to represent periods of high particle concentration during the respective pass.

7.1 Samples From 23 March 1978

Eight 2-min samples were selected from the 23 March flight. Two samples were selected from each of the four levels. Since there were two passes at 400, 500 and 700 mb, one sample was taken from each of the first six passes. The 850-mb samples came from the last pass.

Data from the two 400-mb samples are shown in Figure 37. Although separated by 2 hours and 400 miles, the profiles are quite similar. As can be seen from the 2-D shadowgraphs, small snow predominated during both sampling periods. In both cases the largest particles were between 2 and 3 mm in diameter. The only substantial difference was in values of NT, where the earlier sample had much higher numbers of particles. Since LWC values were similar, there evidently were more small particles in this sample, and the particle distributions support this assumption. In both cases, convective clouds predominated, but the convective activity was stronger during the second sampling period.

Data from the two 500-mb samples are shown in Figure 38. At this level in both cases, there were more large particles and the maximum particle size was greater than 5 millimeters. The Form Factors were smaller, thus indicating a

wider distribution of particle sizes. The LWC increased substantially over that observed at 500 mb, as did the average particle size. As was true at 400 mb, the values of NT show the greatest difference between the two passes. Again the standard deviation among the four 30-sec averages was quite large; in the earlier sample, it was one-third of the mean value. As was frequently the case, the Form Factor was the most consistent variable.

Data from the 700-mb samples appear in Figure 39. This level was close to the freezing level, and as a result, wet snow predominated. The second pass in the more uniform convective activity, yielded some of the highest values of the LWC observed on any MC-130E flights over the continental United States. The total number of particles also changed between the earlier and the later sampling period. The more intense convective activity produced both a greater number of particles and a larger liquid water content. Even the Form Factor showed a difference; the larger value observed during the first sampling period also had a large standard deviation. In the first case, therefore, the particle sizes and their distributions were consistent both with time and at a given moment.

Comparing the two quadrants shows that convective activity prevailed throughout the storm at this time. In both quadrants, the cloud cover was sporadic and conditions changed rapidly, both in time and space. The northeast quadrant, however, was becoming the more intense. Cloud cover there was more extensive, and the warm, moist flow from the Gulf of Mexico was causing the storm to intensify and become better organized.

In the three preceding instances, the two sampling periods represented different sampling passes. In the remaining cases, both sampling periods were extracted from the same pass.

In the case of the 850-mb data shown in Figure 40, both samples were taken from Pass VII, which was part of the series which contained the later samples at higher levels. At this level, the temperature was well above the freezing point, and thus almost all of the precipitation observed was in liquid form as can be seen by the predominance of round particles on the 2-D shadowgraphs. Particle size and LWC have decreased from the 700-mb values. The low numbers of particles, low LWC and low Form Factor indicate that drops and droplets of a variety of sizes existed at this level, but that heaviest concentration of water was near the freezing level.

The four levels sampled on this first day provided a vertical cross section of this young, convective system. Perhaps the most consistent variable was the Form Factor. The range of values of the Form Factor on this flight was the smallest of any of the flights in this series. Thus, while the particle size type, density, and LWC changed, the type of size distribution remained relatively consistent with altitude. As the system became more stratified, this consistency diminished, and Form Factors at higher levels became larger, while those at lower levels varied widely.

TIME: 2040-2042Z
 PARTICLE TYPE: Small Snow

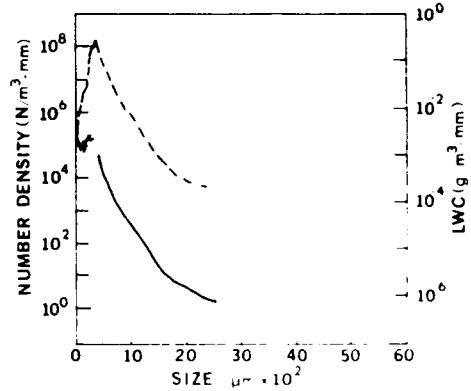
	TEMP C	ALT KM	LWC g/m ³	Z RH%+6/RH%3	DO	NH N/H+3	FF
MEAN	-34.2	7.3	.0900	2.2E+00	184	152224	.33
STANDARD DEVIATION	.2	.0	.0436	1.0E+00	9	83413	.01



PARTICLE SIZE DISTRIBUTION (N/H₀+3-RH)

SIZE (μm)	SCATTER PROBE (RH)	SIZE PROBE (RH)	CLOUD PROBE (RH)	SIZE PROBE (RH)	PRECIP PROBE
2	5.60E+00	27	3.5PE+05	466	3.64E+04
4	6.04E+00	50	4.5PE+04	744	2.1PE+03
6	5.32E+00	73	7.61E+04	1009	2.98E+02
8	3.84E+00	96	1.44E+05	1434	3.49E+01
10	2.68E+00	119	1.61E+05	1779	7.01E+00
12	1.88E+00	142	1.17E+05	2124	2.90E+00
14	1.29E+00	165	1.09E+05	2469	1.88E+00
16	1.27E+00	188	5.81E+04	2814	0.
18	9.63E+07	211	1.05E+05	3159	0.
20	6.24E+07	234	1.73E+05	3504	0.
22	4.69E+07	257	1.57E+05	3849	0.
24	4.62E+07	280	1.17E+05	4194	0.
26	4.54E+07	303	1.34E+05	4539	0.
28	4.01E+07	326	1.54E+05	4884	0.
30	3.29E+07	349	1.21E+05	5229	0.

LWC 7.02E-03 4.75E-02 5.05E-02



TIME: 2244-2246Z
 PARTICLE TYPE: Small Snow

	TEMP C	ALT KM	LWC g/m ³	Z RH%+6/RH%3	DO	NH N/H+3	FF
MEAN	-29.3	7.3	.0810	7.0E+00	314	21259	.46
STANDARD DEVIATION	.1	.0	.0080	7.3E-01	5	2842	.41



PARTICLE SIZE DISTRIBUTION (N/H₀+3-RH)

SIZE (μm)	SCATTER PROBE (RH)	SIZE PROBE (RH)	CLOUD PROBE (RH)	SIZE PROBE (RH)	PRECIP PROBE
2	5.14E+00	27	2.23E+05	466	9.11E+03
4	6.05E+00	50	2.54E+05	744	8.14E+03
6	4.47E+00	73	7.04E+04	1009	1.39E+03
8	3.16E+00	96	8.29E+04	1434	2.82E+02
10	2.00E+00	119	7.07E+04	1779	6.32E+01
12	1.35E+00	142	6.32E+04	2124	2.97E+01
14	9.17E+07	165	3.86E+04	2469	1.87E+01
16	8.92E+07	188	1.40E+04	2814	1.14E+00
18	6.31E+07	211	3.11E+04	3159	0.
20	3.73E+07	234	1.32E+04	3504	0.
22	2.91E+07	257	9.78E+03	3849	0.
24	2.45E+07	280	4.04E+03	4194	0.
26	2.03E+07	303	5.33E+03	4539	0.
28	2.24E+07	326	9.87E+03	4884	0.
30	2.07E+07	349	9.73E+03	5229	0.

LWC 4.37E-03 5.00E-03 7.60E-02

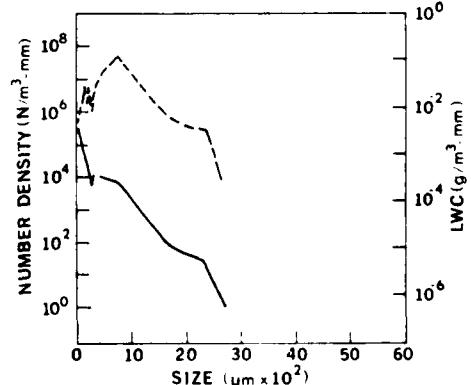
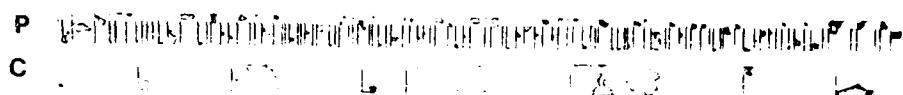


Figure 37. Sample Data From 400 mb - 23 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

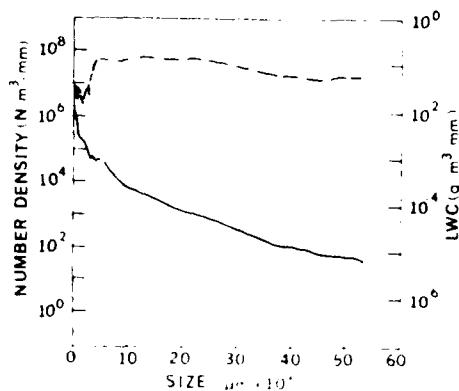
TIME: 1019-2319Z
 PARTICLE TYPE: Latent Show
 MEAN
 STANDARD DEVIATION

	TEMP	ALT	LWC	Z	DO	WT	FF
	C	km	g m ⁻³	km	%	kg m ⁻³	
	-20.9	5.6	.6339	8.5E+02	674	69211	.17
	+1	-0	.2858	5.9E+02	100	23421	.01



PARTICLE SIZE DISTRIBUTION (N/m³-mm)

SIZE (μm)	SCATTER (NU)	SIZE (μm)	CLOUD (NU)	SIZE (μm)	PRECIP (NU)
2	1.51E+08	27	7.27E+05	466	3.02E+04
4	5.52E+08	50	1.14E+04	744	8.90E+03
6	8.30E+08	73	2.87E+05	1089	4.36E+03
8	8.19E+08	96	2.19E+03	1434	2.34E+03
10	6.60E+08	119	1.99E+05	1779	1.30E+03
12	4.92E+08	142	1.31E+05	2124	8.03E+02
14	3.49E+08	165	9.86E+04	2469	5.98E+02
16	3.20E+08	188	4.55E+04	2814	3.38E+02
18	2.25E+08	211	7.64E+04	3159	2.22E+02
20	1.29E+08	234	6.13E+04	3504	1.42E+02
22	1.04E+08	257	5.38E+04	3849	8.70E+01
24	8.04E+07	280	4.22E+04	4194	7.27E+01
26	7.67E+07	303	4.83E+04	4539	4.81E+01
28	6.20E+07	326	5.60E+04	4884	4.81E+01
30	7.09E+07	349	5.06E+04	5229	4.19E+01
LWC	1.46E-02		2.09E-02		6.13E-01



TIME: 1019-2319Z
 PARTICLE TYPE: Latent Show
 MEAN
 STANDARD DEVIATION

	TEMP	ALT	LWC	Z	DO	WT	FF
	C	km	g m ⁻³	km	%	kg m ⁻³	
	-17.0	5.6	.1434	1.0E+02	541	19946	.20
	+2	-0	.0048	1.3E+01	20	2605	.01



PARTICLE SIZE DISTRIBUTION (N/m³-mm)

SIZE (μm)	SCATTER (NU)	SIZE (μm)	CLOUD (NU)	SIZE (μm)	PRECIP (NU)
2	4.39E+08	27	1.89E+05	466	1.36E+04
4	4.03E+08	50	1.04E+05	744	2.87E+03
6	4.37E+08	73	6.03E+04	1089	1.30E+03
8	3.59E+08	96	8.37E+04	1434	6.54E+02
10	2.70E+08	119	7.84E+04	1779	3.54E+02
12	2.01E+08	142	5.63E+04	2124	2.01E+02
14	1.40E+08	165	4.30E+04	2469	1.12E+02
16	1.52E+08	188	1.81E+04	2814	5.60E+01
18	1.10E+08	211	4.31E+04	3159	2.72E+01
20	7.10E+07	234	3.78E+04	3504	1.58E+01
22	6.17E+07	257	3.38E+04	3849	1.08E+01
24	5.14E+07	280	2.23E+04	4194	7.15E+00
26	5.31E+07	303	2.57E+04	4539	3.90E+00
28	4.93E+07	326	3.00E+04	4884	3.63E+00
30	6.10E+07	349	2.64E+04	5229	1.12E+00
LWC	8.72E-03		1.04E-02		1.33E-01

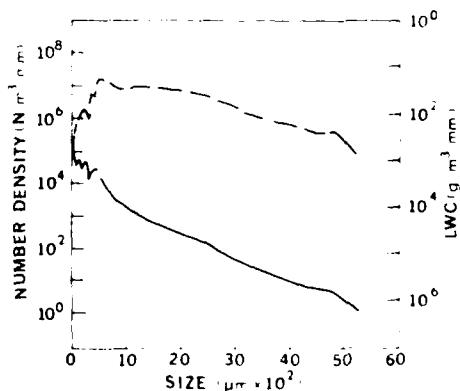


Figure 38. Sample Data From 500 mb - 23 March 1973. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min periods.

TIME: 2140-2142Z
PARTICLE TYPE: Wet Snow

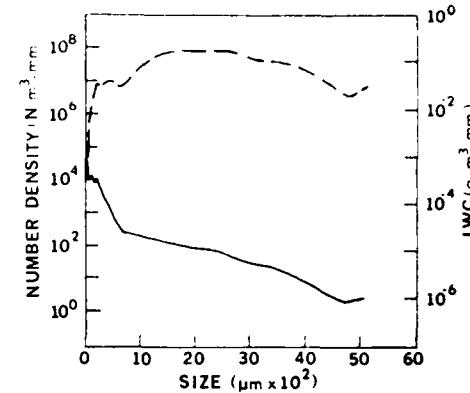
	TEMP C	ALT KM	LWC g/m ³	Z KM+6/RM+3	DO HU	NT N/m ³	FF
MEAN	-1.3	3.0	.4212	7.8E+03	1679	5295	.26
STANDARD DEVIATION	.2	.0	.5836	7.4E+03	38	4793	.04



PARTICLE SIZE DISTRIBUTION (N/m³-MM)

SIZE (MM)	SCATTER (HU)	SIZE (MM)	CLOUD (HU)	SIZE (MM)	PRECIP (HU)
PROBE	PROBE	PROBE	PROBE	PROBE	PROBE
2	5.34E+07	23	2.73E+05	412	1.81E+03
4	2.42E+07	43	5.52E+04	648	3.25E+02
6	3.59E+07	73	1.50E+04	1089	2.43E+02
8	4.54E+07	96	1.81E+04	1434	1.97E+02
10	4.04E+07	119	2.14E+04	1779	1.29E+02
12	4.24E+07	142	1.70E+04	2124	9.27E+01
14	3.42E+07	165	1.28E+04	2469	7.35E+01
16	2.80E+07	188	1.12E+04	2814	4.06E+01
18	2.44E+07	211	1.52E+04	3159	2.47E+01
20	1.55E+07	234	7.87E+03	3504	2.10E+01
22	1.31E+07	257	7.68E+03	3849	1.40E+01
24	7.30E+06	280	4.81E+03	4194	7.70E+00
26	1.02E+07	303	4.09E+03	4539	3.42E+00
28	6.27E+06	326	3.70E+03	4884	1.52E+00
30	8.62E+06	349	3.02E+03	5229	2.13E+00

LWC 1.50E-03 1.32E-02 6.08E-01



TIME: 2354-2356Z
PARTICLE TYPE: Wet Snow

	TEMP C	ALT KM	LWC g/m ³	Z KM+6/RM+3	DO HU	NT N/m ³	FF
MEAN	-1.3	3.0	2.5891	6.2E+04	1844	20267	.17
STANDARD DEVIATION	.1	.0	.1974	3.2E+03	49	1994	.01



PARTICLE SIZE DISTRIBUTION (N/m³-MM)

SIZE (MM)	SCATTER (HU)	SIZE (MM)	CLOUD (HU)	SIZE (MM)	PRECIP (HU)
PROBE	PROBE	PROBE	PROBE	PROBE	PROBE
2	3.02E+07	23	7.66E+05	412	1.20E+04
4	2.11E+07	43	1.21E+05	648	2.71E+03
6	2.35E+07	73	5.50E+04	1089	1.03E+03
8	1.52E+07	96	4.29E+04	1434	8.93E+02
10	1.12E+07	119	5.87E+04	1779	1.79E+02
12	8.76E+07	142	8.77E+04	2124	2.94E+02
14	5.75E+07	165	7.88E+04	2469	2.02E+02
16	5.35E+07	188	4.45E+04	2814	1.35E+02
18	2.91E+07	211	7.66E+04	3159	9.82E+01
20	2.44E+07	234	4.50E+04	3504	8.23E+01
22	2.20E+07	257	3.65E+04	3849	6.38E+01
24	1.91E+07	280	1.86E+04	4194	5.04E+01
26	1.69E+07	303	1.76E+04	4539	3.76E+01
28	1.42E+07	326	2.00E+04	4884	3.47E+01
30	1.29E+07	349	1.80E+04	5229	2.39E+01

LWC 3.04E-03 6.47E-02 2.52E+00

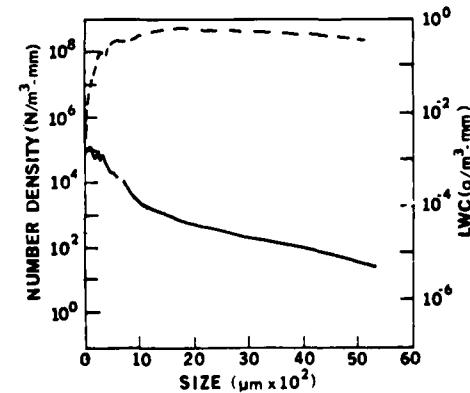


Figure 39. Sample Data From 700 mb - 23 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

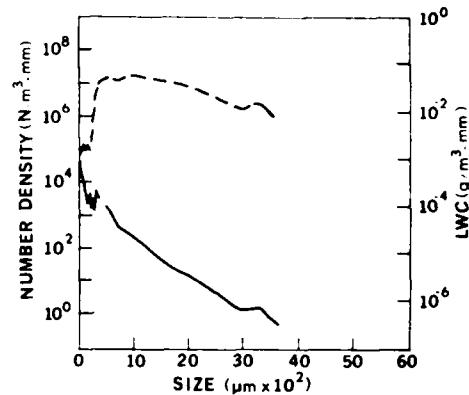
TIME: 0020-0022Z
 PARTICLE TYPE: Rain
 MEAN
 STANDARD DEVIATION

	TEMP C	ALT KH	LUC D/N=3	Z NH=6/N=3	BO MU	NT N/N=3	FF
	9.6	1.5	.1669	2.2E+02	1328	2037	.13
	.3	.0	.0436	1.1E+03	127	470	.03



PARTICLE SIZE DISTRIBUTION (N/N=3-NH)					
SIZE (NU)	SCATTER PROBE	SIZE (NU)	CLOUD PROBE	SIZE (NU)	PRECIP PROBE
2	1.98E+08	23	2.12E+05	405	2.18E+03
4	1.04E+08	43	4.10E+04	448	4.55E+02
6	6.34E+07	63	1.92E+04	945	1.70E+02
8	3.04E+07	83	3.15E+03	1242	7.77E+01
10	1.64E+07	103	4.94E+03	1539	3.20E+01
12	8.62E+06	122	2.59E+03	1836	1.75E+01
14	4.40E+06	142	5.78E+03	2133	9.27E+00
16	3.02E+06	162	1.49E+03	2430	4.20E+00
18	3.24E+06	182	3.65E+03	2727	1.95E+00
20	1.14E+06	202	2.38E+03	3024	1.04E+00
22	1.84E+06	221	5.60E+03	3321	1.13E+00
24	3.48E+05	241	5.82E+03	3618	4.22E-01
26	6.98E+05	261	5.19E+03	3915	0.
28	4.63E+05	281	5.07E+03	4212	0.
30	1.04E+06	301	4.42E+03	4509	0.

LUC 2.22E-04 5.76E-03 1.61E-01



TIME: 0034-0036Z
 PARTICLE TYPE: Rain
 MEAN
 STANDARD DEVIATION

	TEMP C	ALT KH	LUC D/N=3	Z NH=6/N=3	BO MU	NT N/N=3	FF
	8.5	1.5	.1612	3.6E+02	1903	2602	.12
	.3	.0	.0118	1.0E+03	191	2012	.02



PARTICLE SIZE DISTRIBUTION (N/N=3-NH)					
SIZE (NU)	SCATTER PROBE	SIZE (NU)	CLOUD PROBE	SIZE (NU)	PRECIP PROBE
2	2.40E+09	23	1.49E+05	405	5.44E+02
4	8.09E+07	43	7.43E+04	448	1.11E+02
6	3.57E+07	63	3.47E+03	945	9.49E+01
8	1.00E+07	83	1.04E+04	1242	6.35E+01
10	1.52E+08	103	9.18E+03	1539	4.44E+01
12	1.52E+07	122	3.15E+03	1836	2.21E+01
14	2.92E+07	142	3.20E+03	2133	1.47E+01
16	3.38E+06	162	2.04E+03	2430	7.32E+00
18	4.31E+06	182	2.57E+03	2727	2.91E+00
20	1.52E+06	202	1.60E+03	3024	2.00E+00
22	2.45E+06	221	3.97E+03	3321	1.12E+00
24	1.87E+06	241	2.45E+03	3618	0.
26	7.02E+05	261	1.46E+03	3915	9.12E-01
28	1.29E+06	281	1.34E+03	4212	0.
30	1.40E+06	301	1.15E+03	4509	0.

LUC 2.81E-03 2.52E-03 1.59E-01

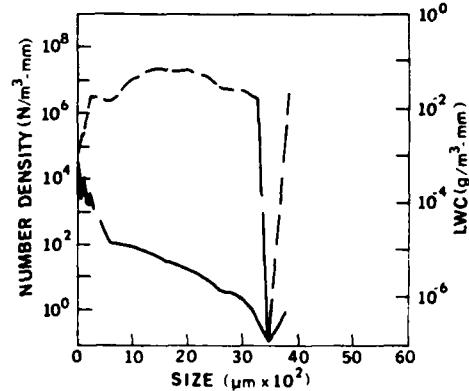


Figure 40. Sample Data From 850 mb - 23 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

7.2 Samples From 24 March 1978

Two samples were taken from each of the four passes completed on 24 March. Each sample was 2 min in length. By this time, the storm system was a mature open wave.

The samples taken at 400 mb are shown in Figure 41. As had been the case on 23 March, both show maximum particle sizes of approximately 2.5 millimeters. The Form Factors are quite high and also quite consistent; those of the first sample averaging 0.60. This and the relatively low liquid water content indicate a predominance of small particles of uniform size as can be seen in the plots. The medium volume diameters were similar to those observed at 400 mb on the previous day. In general, the change in cloud structure at 400 mb was smaller than at the lower levels.

The samples taken at 500 mb appear in Figure 42. The maximum particle size and medium volume diameter increased substantially when going from 400 to 500 mb, but not as much as on the previous day. Liquid water content, however, was low, especially during the first sampling period, where the mean value was only 9×10^{-3} g/m³. The Form Factor remained high, and showed less consistency than usual. Thus there was a greater variety of distributions of particles at this level. The weather was caused mainly by the warm air overrunning the colder air north of the front. The warm air was relatively stable, keeping most of the moisture at lower levels. The variance of the Form Factor may be due to the isolated convective activity still present at this time.

The 700-mb level also showed some interesting contrasts. As was noted earlier (see Table 2), a variety of crystal types was present at this level. Data from this level are displayed in Figure 43. Although both samples show many large particles, the number, liquid water content, and Form Factor vary greatly from the first sample to the second. They were taken 14 min apart and in both cases the airplane was in thick clouds. While on 23 March the 700-mb surface was close to the freezing level, on 24 March temperatures were still well below freezing. Needles, large snow, wet snow, and supercooled rain were all present. The aircraft did experience some icing. Small particles were comparatively rare, especially during the second sample. The 2-D cloud probe recorded an unusually small quantity of data. Several channels of the scatter probe failed to record any particles; a highly unusual situation in this type of cloudiness. Thus, despite the uniform appearance, there was still a variety of particle distributions at this level.

The situation was similar at 850 mb, as seen in Figure 44. Again, there was wide divergence in liquid water content and Form Factor. Again, there were a variety of particles recorded by the 2-D system. Here the aircraft was closer to the freezing level and rain was more plentiful. The Mission Director reported rain,

generally mixed with snow, several times during the pass (see Appendix A). There were comparatively few smaller particles especially during the earlier period. This may be a result either of accretion that occurred at higher levels or of sublimation of the smaller particles.

The 24 March flight took place when the storm system was changing in character. It was much more widespread than it had been the previous day and it provided precipitation to much of the central United States. The clouds, however, were far from uniform. At times they had very large liquid water contents values, but at other times, they had little moisture. The low pressure area was deepening and soon the fronts would begin to occlude.

7.3 Samples From 25 March 1978

On 25 March, the fronts had occluded, and the system contained a large amount of cloud. Although they covered a large area, the clouds sampled did not contain as much liquid water as they had the previous day. As a result, while precipitation was more widespread, it was generally less intense.

The sampling procedure was the same as the previous day. Samples, each 2 min long, were selected from each of the four passes for study.

Figure 45 shows the resultant data from 400 millibars. Unlike previous days, at this time clouds were not continuous at 400 millibars. The liquid water content was low. This was the result of a lack of large particles, as the 2-D data show clearly. The Form Factor in both samples was high. Values were generally 0.50 or higher. Unlike the 24 March case, this time the Form Factor was quite consistent indicating a uniformity to the particle size distributions in the high clouds which had not been there the day before.

Figure 46 shows that the same uniformity was present at 500 millibars. Again, there were few large particles and low liquid water content values observed during both sampling periods. This was the only case in the four flights during which the Form Factor did not decrease when going from 400 to 500 millibars. The moisture in the system was spread over a larger geographical area and the moisture at a given location was less. The number of particles had only decreased slightly, but the medium volume diameter and maximum size had both become much smaller. In addition, most of the clouds were confined to lower levels. Occasionally while at 500 mb the aircraft was in clear air with blue sky above. This was in contrast to the solid overcasts observed at 500 mb on previous days.

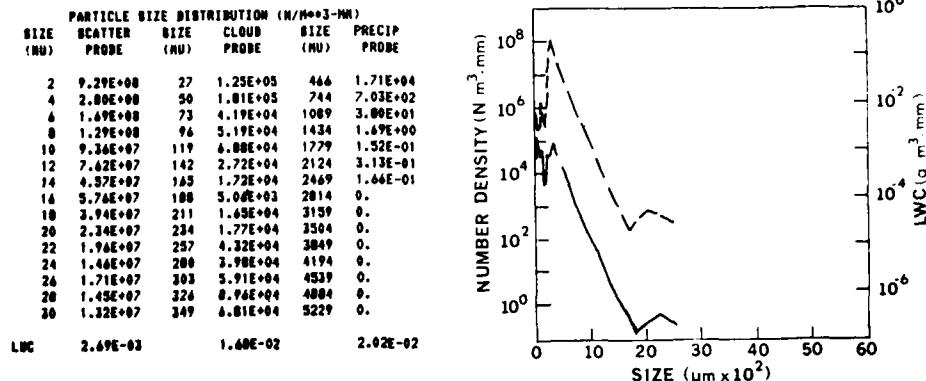
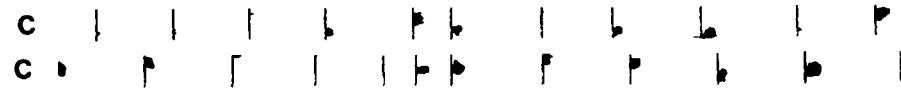
The 700-mb data are shown in Figure 47. Although the first sample had the highest average particle count of any sample period, the liquid water content was low. Small particles predominated. The Form Factor was unusually low since there was a fairly uniform distribution of particles throughout the range of the scatter probe. The low Form Factor and low liquid water content were also seen in the second sample, however, the particle count had dropped from 1.6×10^6 to a more normal 2.1×10^5 particles per cubic meter. The medium volume diameter had increased, as had the maximum particle size. Although the temperature was still -4°C , most of the particles were in the form of small water droplets. The aircraft experienced considerable icing during this pass. The 2-D probes rarely gave representative shadowgraphs since water and ice caught on the optical sensors and produced long, meaningless "streaks". This phenomena, called "streaking" is frequently observed in liquid precipitation. During this time, some surface stations nearby were reporting freezing rain.

Data from the 850-mb samples are shown in Figure 48. The temperature reported by the aircraft varied drastically during this pass and as a result the first sample occurred at a temperature well below freezing while the second occurred while the temperature was above freezing. Precipitation varied from snow to freezing rain to rain. In both cases, the liquid water content was small. Average Form Factors were both near 0.20 which is a moderate value for this variable at this level. The maximum particle size was quite large (over $400 \mu\text{m}$) during the first sample in large snow, while it was somewhat smaller (less than $2500 \mu\text{m}$) in the rain.

The 25 March flights explored a deep low pressure area with an occluded front extending well to the south. Thus most of the moisture in the system remained well to the south of the sampling aircraft. As a result, the clouds while wide spread, contained relatively little moisture. At the time, the system appeared to be weakening, but during the next 24 hours an influx of moisture from the Atlantic Ocean caused the system to reintensify.

TIME: 1946-1948Z
 PARTICLE TYPE: Small Snow

	TEMP C	ALT KM	LUC G/H=3	Z MM=6/M=3	DO HU	WT H=3	FF
MEAN	-32.0	7.3	.0370	7.0E-01	190	19911	.60
STANDARD DEVIATION	.2	.0	.0054	9.9E-02	9	3304	.04



TIME: 2000-2002Z
 PARTICLE TYPE: Small Snow

	TEMP C	ALT KM	LUC G/H=3	Z MM=6/M=3	DO HU	WT H=3	FF
MEAN	-32.6	7.3	.0354	2.2E+00	295	10717	.60
STANDARD DEVIATION	.2	.0	.0067	6.1E-01	6	1538	.01

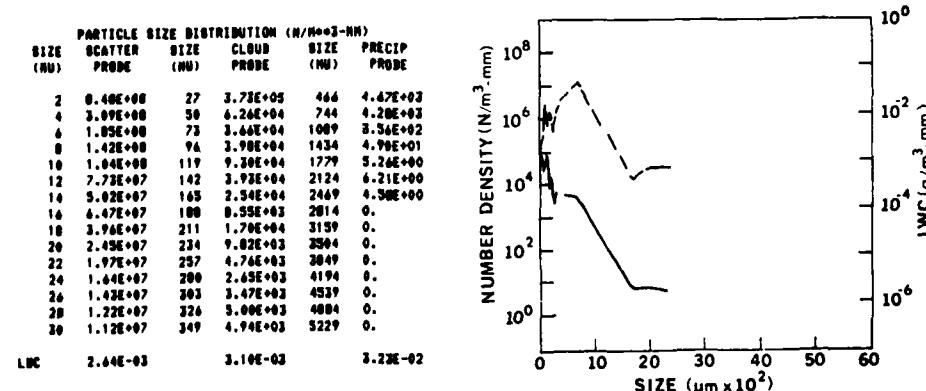
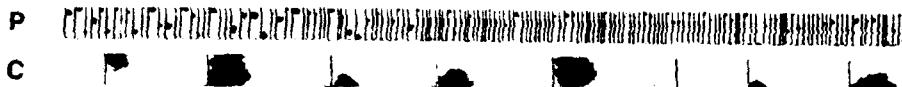


Figure 41. Sample Data From 400 mb - 24 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

TIME: 2014-2020Z
 PARTICLE TYPE: Large Snow

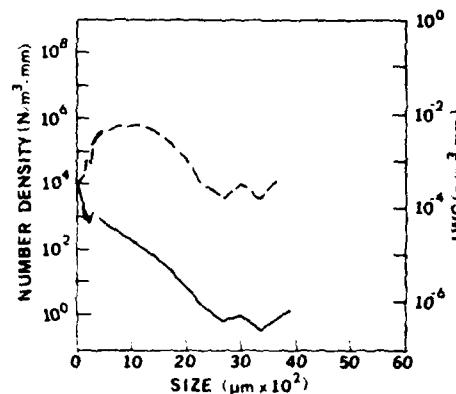
	MEAN	STANDARD DEVIATION	TEMP C	ALT KM	LWC G/m ³	Z MH ⁻⁶ /MH ⁻³	DO MU	NT N/MH ⁻³	FF
			-26.4	5.6	.0090	2.7E+00	434	931	.41
			.2	.0	.0030	1.5E+00	43	397	.72



PARTICLE SIZE DISTRIBUTION (N/M⁻³-MH)

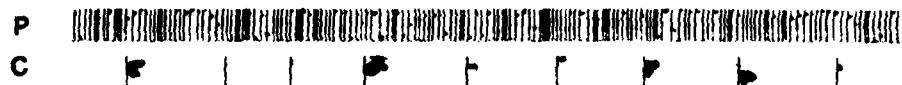
SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	1.25E+09	27	0.	466	2.56E+02
4	3.86E+09	50	7.53E+03	744	3.26E+02
6	7.06E+09	73	4.74E+03	1089	1.59E+02
8	5.97E+09	96	2.81E+03	1434	6.94E+01
10	4.00E+09	119	1.91E+03	1779	2.37E+01
12	2.72E+09	142	1.08E+03	2124	5.37E+00
14	1.35E+09	165	1.39E+03	2469	1.14E+00
16	1.44E+09	188	6.87E+02	2814	4.09E-01
18	4.80E+08	211	1.24E+03	3159	4.55E-01
20	7.49E+07	234	0.	3504	2.35E-01
22	1.97E+07	257	5.94E+02	3849	5.09E-01
24	7.28E+06	280	0.	4194	0.
26	9.00E+06	303	6.24E+02	4539	0.
28	1.52E+07	326	1.25E+03	4884	0.
30	1.77E+07	349	1.15E+03	5229	0.

LWC 3.07E-02 2.82E-04 0.77E-03



TIME: 2038-2040Z
 PARTICLE TYPE: Small Snow

	MEAN	STANDARD DEVIATION	TEMP C	ALT KM	LWC G/m ³	Z MH ⁻⁶ /MH ⁻³	DO MU	NT N/MH ⁻³	FF
			-26.4	5.7	.0669	7.6E+00	334	14111	.40
			.1	.0	.0044	1.4E+00	4	2004	.93



PARTICLE SIZE DISTRIBUTION (N/M⁻³-MH)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	6.91E+08	27	9.77E+04	466	4.61E+02
4	4.10E+08	50	1.73E+05	744	5.80E+02
6	3.09E+08	73	3.38E+04	1089	1.55E+03
8	2.50E+08	96	4.53E+04	1434	3.35E+02
10	1.00E+08	119	5.29E+04	1779	9.63E+01
12	1.55E+08	142	4.97E+04	2124	3.13E+01
14	1.07E+08	165	3.00E+04	2469	1.70E+01
16	1.20E+08	188	1.00E+04	2814	1.04E+00
18	6.74E+07	211	2.03E+04	3159	2.27E-01
20	5.24E+07	234	1.14E+04	3504	0.
22	4.32E+07	257	1.04E+04	3849	2.59E-01
24	3.53E+07	280	3.72E+03	4194	2.81E-01
26	3.47E+07	303	3.61E+03	4539	0.
28	2.09E+07	326	4.31E+03	4884	3.44E-01
30	2.67E+07	349	4.35E+03	5229	3.07E-01

LWC 5.67E-03 3.45E-03 4.35E-02

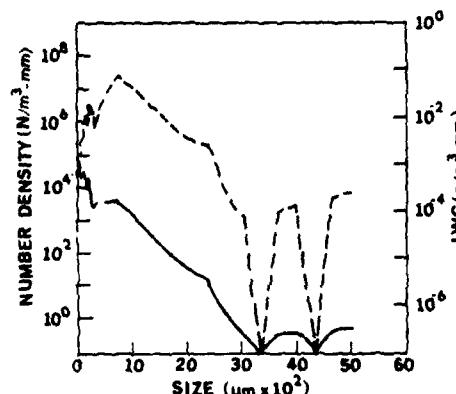


Figure 42. Sample Data From 500 mb - 24 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

TIME: 2108-2110Z
PARTICLE TYPE: Wet Snow

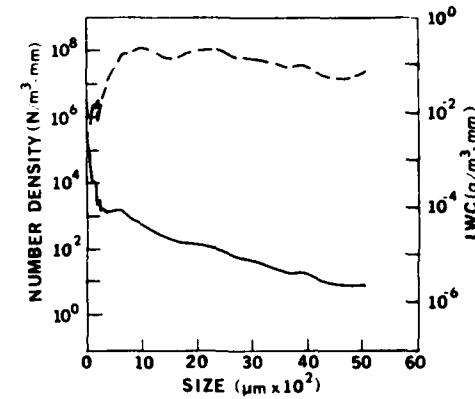
	TEMP C	ALT KM	LWC g/m ³	Z Km+6/R=+3	DO N1 N/H=+3	FF
MEAN	-5.2	3.0	1.1578	1.5E+04	1710 11597 .10	
STANDARD DEVIATION	.1	.0	.4699	1.1E+04	331 2260 .04	



PARTICLE SIZE DISTRIBUTION (N/H=+3-HH)

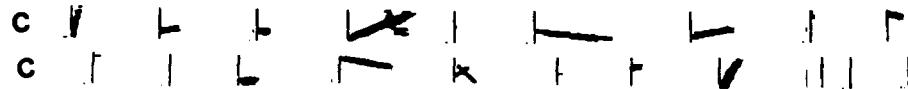
SIZE (MM)	SCATTER PROBE (HU)	SIZE PROBE (HU)	CLOUD PROBE (HU)	PRECIP PROBE (HU)	
2	2.84E+08	23	1.97E+07	412	1.75E+03
4	5.82E+08	43	2.84E+05	648	1.74E+03
6	4.89E+08	73	4.96E+04	1089	6.46E+02
8	3.52E+08	96	1.37E+04	1434	2.47E+02
10	2.64E+08	119	1.81E+04	1729	1.72E+02
12	1.91E+08	142	1.58E+04	2124	1.61E+02
14	1.44E+08	165	1.02E+04	2469	1.17E+02
16	1.23E+08	188	2.62E+03	2814	6.90E+01
18	9.04E+07	211	3.39E+03	3159	4.51E+01
20	7.19E+07	234	4.02E+03	3504	3.23E+01
22	5.43E+07	257	1.46E+03	3849	2.00E+01
24	4.59E+07	280	2.24E+03	4194	1.80E+01
26	3.93E+07	303	2.06E+03	4539	9.71E+00
28	3.15E+07	326	1.91E+03	4884	7.33E+00
30	3.15E+07	349	1.86E+03	5229	7.81E+00

LWC 6.03E-03 9.35E-03 1.15E+00



TIME: 2122-2124Z
PARTICLE TYPE: Needles

	TEMP C	ALT KM	LWC g/m ³	Z Km+6/R=+3	DO N1 N/H=+3	FF
MEAN	-5.4	3.0	1.1387	1.2E+01	275 44786 .27	
STANDARD DEVIATION	.1	.0	.0120	2.0E+00	7 4929 .04	



PARTICLE SIZE DISTRIBUTION (N/H=+3-HH)

SIZE (MM)	SCATTER PROBE (HU)	SIZE PROBE (HU)	CLOUD PROBE (HU)	PRECIP PROBE (HU)	
2	3.00E+08	65	2.63E+07	692	1.47E+04
4	3.29E+07	73	6.45E+04	1092	1.38E+04
6	1.49E+07	98	3.08E+05	1476	2.44E+03
8	5.61E+06	124	1.34E+05	1860	1.00E+03
10	2.15E+06	150	3.86E+05	2244	4.14E+02
12	9.46E+05	175	1.49E+05	2628	2.34E+02
14	1.00E+06	201	9.14E+04	3012	1.32E+02
16	2.17E+05	226	3.47E+04	3396	4.35E+01
18	1.05E+05	252	3.44E+04	3780	2.32E+01
20	1.02E+05	278	3.10E+04	4164	1.21E+01
22	0.	303	3.22E+04	4548	5.12E+00
24	0.	329	1.98E+04	4932	4.67E+00
26	1.09E+03	354	1.74E+04	5316	2.26E+00
28	0.	380	1.55E+04	5700	5.30E+00
30	0.	406	1.54E+04	6084	2.42E+00

LWC 2.60E-05 1.65E-02 1.22E-01

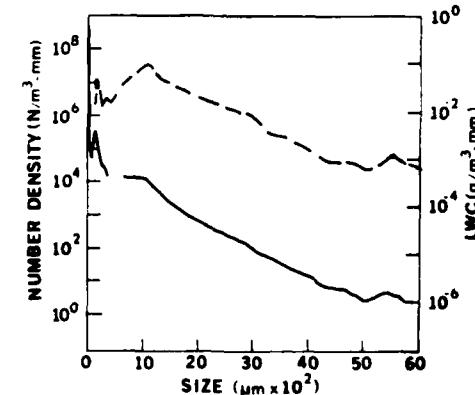


Figure 43. Sample Data From 700 mb - 24 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

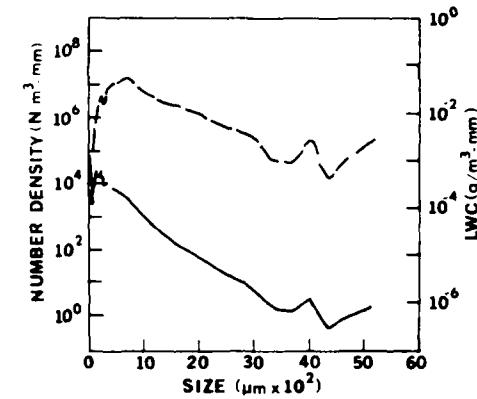
TIME: 1336-2138Z
 PARTICLE TYPE: Large Snow

	TEMP C	ALT KH	LWC g/m ³	Z Hm+6/Hm+3	D0 HU	NT N/Hm+3	FF
MEAN	-2.4	1.4	.0795	3.1E+01	370	10542	.20
STANDARD DEVIATION	.1	.0	.0086	1.0E+01	37	1661	.08



PARTICLE SIZE DISTRIBUTION (N/Hm+3-HM)					
SIZE (HM)	SCATTER PROBE	SIZE PROBE	CLOUD PROBE	SIZE PROBE	PRECIP PROBE
2	4.86E+08	27	9.83E+04	466	9.70E+03
4	1.82E+07	50	2.39E+04	744	4.35E+03
6	7.00E+06	73	1.04E+03	1089	8.77E+02
8	2.49E+06	96	2.34E+04	1424	2.00E+02
10	2.12E+06	119	2.40E+04	1779	1.15E+02
12	2.35E+05	142	3.37E+04	2124	6.01E+01
14	1.07E+04	165	2.84E+04	2469	2.54E+01
16	2.39E+03	188	2.12E+04	2814	1.29E+01
18	2.36E+03	211	2.77E+04	3159	6.72E+00
20	0.	234	2.16E+04	3504	1.80E+00
22	1.20E+03	257	2.24E+04	3849	1.30E+00
24	0.	280	1.15E+04	4194	3.19E+00
26	0.	303	1.38E+04	4539	3.87E-01
28	0.	326	1.49E+04	4884	8.74E-01
30	0.	349	1.28E+04	5229	1.45E+00

LWC 2.11E-03 5.73E-03 7.38E-02



TIME: 2150-2152Z
 PARTICLE TYPE: Large Snow

	TEMP C	ALT KH	LWC g/m ³	Z Hm+6/Hm+3	D0 HU	NT N/Hm+3	FF
MEAN	-1.0	1.5	.2038	4.7E+02	848	17942	.19
STANDARD DEVIATION	.1	.0	.0336	2.2E+01	47	1904	.01



PARTICLE SIZE DISTRIBUTION (N/Hm+3-HM)					
SIZE (HM)	SCATTER PROBE	SIZE PROBE	CLOUD PROBE	SIZE PROBE	PRECIP PROBE
2	3.32E+08	27	3.13E+05	466	8.05E+03
4	3.83E+07	50	4.96E+04	744	1.36E+03
6	1.85E+07	73	4.90E+04	1089	1.00E+03
8	7.62E+06	96	5.39E+04	1434	7.57E+02
10	3.58E+06	119	5.33E+04	1779	5.42E+02
12	2.19E+06	142	5.56E+04	2124	4.07E+02
14	1.85E+06	165	7.29E+04	2469	2.82E+02
16	1.36E+06	188	3.99E+04	2814	1.94E+02
18	5.79E+05	211	5.37E+04	3159	1.44E+02
20	6.73E+05	234	3.67E+04	3504	1.01E+02
22	8.10E+05	257	3.71E+04	3849	6.24E+01
24	3.48E+05	280	1.64E+04	4194	5.00E+01
26	1.15E+05	303	1.93E+04	4539	3.15E+01
28	2.31E+05	326	2.02E+04	4884	2.61E+01
30	1.15E+05	349	1.73E+04	5229	2.11E+01

LWC 7.15E-05 9.40E-03 2.74E-01

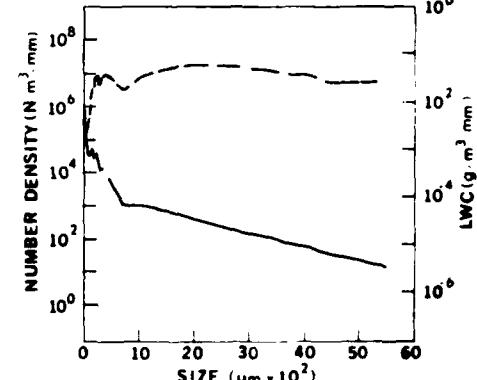
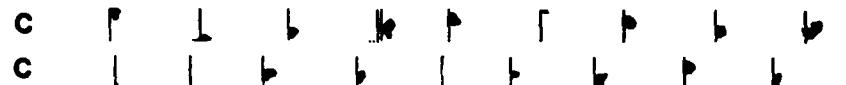


Figure 44. Sample Data From 850 mb - 24 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

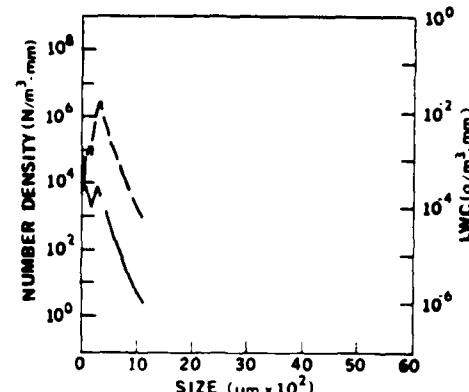
TIME: 1804-1806Z
PARTICLE TYPE: Small Snow

	TEMP C	ALT KM	LWC g/m ³	Z km+6/km+3	DO NU	NT N/km ³	FF
MEAN	-32.7	7.3	.0040	6.2E-02	182	3464	.02
STANDARD DEVIATION	.1	.0	.0024	2.4E-02	7	2410	.04



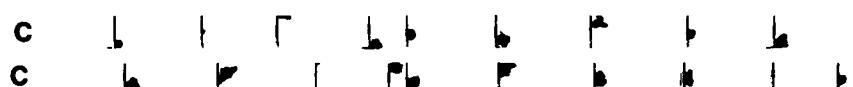
PARTICLE SIZE DISTRIBUTION (N/km ³ -HN)					
SIZE (HN)	SCATTER PROBE	SIZE (HN)	CLOUD PROBE	SIZE (HN)	PRECIP PROBE
2	3.20E+09	27	3.46E+04	466	1.34E+03
4	9.83E+07	50	9.24E+04	744	5.43E+01
6	3.81E+07	73	7.49E+03	1089	2.34E+00
8	3.32E+07	96	1.21E+04	1434	0.
10	2.39E+07	119	7.33E+03	1779	0.
12	1.80E+07	142	7.37E+03	2124	0.
14	1.16E+07	165	4.03E+03	2469	0.
16	1.13E+07	188	2.29E+03	2814	0.
18	6.49E+06	211	1.59E+03	3159	0.
20	5.14E+06	234	4.09E+02	3504	0.
22	3.79E+06	257	6.20E+02	3849	0.
24	3.45E+06	280	6.30E+02	4194	0.
26	3.24E+06	303	7.74E+02	4539	0.
28	2.66E+06	326	9.47E+02	4884	0.
30	2.66E+06	349	7.09E+02	5229	0.

LWC 4.05E-04 2.24E-03 1.74E-03



TIME: 1818-1820Z
PARTICLE TYPE: Small Snow

	TEMP C	ALT KM	LWC g/m ³	Z km+6/km+3	DO NU	NT N/km ³	FF
MEAN	-32.0	7.3	.0162	2.3E-01	174	12277	.00
STANDARD DEVIATION	.1	.0	.0040	5.0E-02	5	2982	.03



PARTICLE SIZE DISTRIBUTION (N/km ³ -HN)					
SIZE (HN)	SCATTER PROBE	SIZE (HN)	CLOUD PROBE	SIZE (HN)	PRECIP PROBE
2	1.77E+09	27	5.74E+04	466	6.67E+03
4	1.79E+08	50	1.75E+05	744	1.24E+02
6	8.74E+07	73	1.38E+04	1089	1.64E+00
8	6.09E+07	96	2.82E+04	1434	0.
10	4.72E+07	119	2.47E+04	1779	0.
12	4.21E+07	142	1.98E+04	2124	0.
14	2.30E+07	165	1.22E+04	2469	0.
16	3.05E+07	188	3.48E+03	2814	0.
18	2.66E+07	211	1.28E+04	3159	0.
20	1.15E+07	234	2.22E+04	3504	0.
22	9.97E+06	257	2.04E+04	3849	0.
24	8.44E+06	280	2.00E+04	4194	0.
26	8.84E+06	303	1.24E+04	4539	0.
28	8.85E+06	326	5.32E+04	4884	0.
30	6.39E+06	349	3.77E+04	5229	0.

LWC 1.43E-03 9.97E-03 6.68E-03

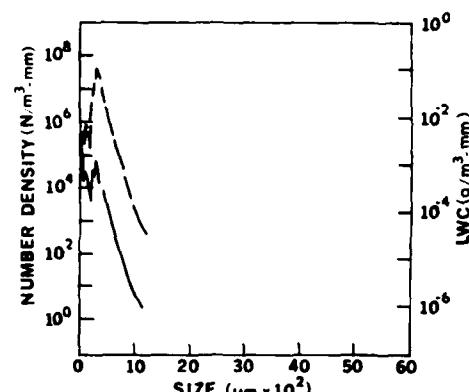


Figure 45. Sample Data From 400 mb - 25 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

TIME: 1828-1830Z
 PARTICLE TYPE: Small Snow
 MEAN
 STANDARD DEVIATION

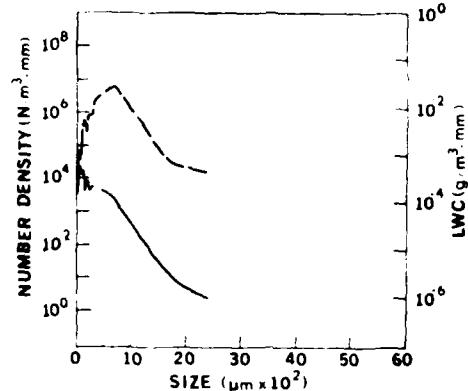
	TEMP C	ALT KH	LWC G/M ³	Z MM+6/MM+3	DO HU	NT N/M ³	FF
	-19.9	5.6	.0286	1.0E+00	294	6660	.50
	.1	.0	.0128	8.7E-01	0	3374	.02



PARTICLE SIZE DISTRIBUTION (N/M³-MM)

SIZE (MM)	SCATTER PROBE	SIZE (MM)	CLOUD PROBE	SIZE (MM)	PRECIP PROBE
2	1.73E+07	27	2.77E+04	466	5.21E+03
4	1.81E+08	50	3.21E+04	744	2.94E+03
6	1.12E+08	73	1.39E+04	1089	3.41E+02
8	6.30E+07	96	3.52E+04	1424	5.13E+01
10	6.27E+07	119	1.97E+04	1779	1.07E+01
12	5.00E+07	142	2.16E+04	2124	5.40E+00
14	3.29E+07	165	1.42E+04	2469	3.39E+00
16	4.14E+07	188	5.08E+03	2814	0.
18	2.78E+07	211	9.02E+03	3159	0.
20	1.62E+07	234	8.77E+03	3504	0.
22	1.35E+07	257	7.31E+03	3849	0.
24	1.22E+07	280	5.34E+03	4194	0.
26	1.04E+07	303	6.25E+03	4539	0.
28	1.13E+07	326	7.12E+03	4884	0.
30	7.84E+06	349	6.76E+03	5229	0.

LWC 1.91E-03 2.69E-03 2.60E-02



TIME: 1841-1843Z
 PARTICLE TYPE: Small Snow
 MEAN
 STANDARD DEVIATION

	TEMP C	ALT KH	LWC G/M ³	Z MM+6/MM+3	DO HU	NT N/M ³	FF
	-21.1	5.6	.0062	1.2E-01	170	3494	.66
	.1	.0	.0024	9.5E-02	28	714	.09



PARTICLE SIZE DISTRIBUTION (N/M³-MM)

SIZE (MM)	SCATTER PROBE	SIZE (MM)	CLOUD PROBE	SIZE (MM)	PRECIP PROBE
2	3.20E+09	27	0.	466	1.95E+03
4	6.07E+07	50	7.34E+03	744	1.19E+02
6	2.97E+07	73	5.74E+03	1089	1.56E+01
8	2.32E+07	96	9.37E+03	1424	2.03E+00
10	1.00E+07	119	8.82E+03	1779	4.96E-01
12	1.34E+07	142	9.29E+03	2124	0.
14	6.75E+06	165	1.19E+04	2469	0.
16	1.00E+07	188	6.44E+03	2814	0.
18	8.50E+06	211	1.40E+04	3159	0.
20	4.78E+06	234	1.68E+04	3504	0.
22	3.75E+06	257	1.42E+04	3849	0.
24	2.59E+06	280	1.16E+04	4194	0.
26	3.64E+06	303	1.08E+04	4539	0.
28	3.57E+06	326	1.02E+04	4884	0.
30	2.50E+06	349	7.63E+03	5229	0.

LWC 5.79E-04 3.53E-03 2.67E-03

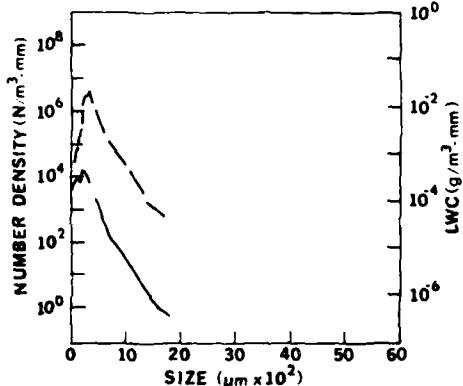


Figure 46. Sample Data From 500 mb - 25 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

TIME: 1902-1904Z
PARTICLE TYPE: Rain

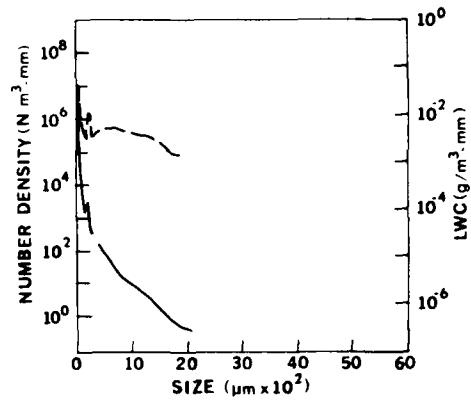
	TEMP C	ALT KM	LWC G/m ³	Z MM+6/MM	DO MU	NT N/m ³	FF
MEAN	-3.7	2.9	.0168	2.9E+01	230	155265	.02
STANDARD DEVIATION	.0	.0	.0063	1.6E+01	131	63339	.00



PARTICLE SIZE DISTRIBUTION (N/m³-MM)

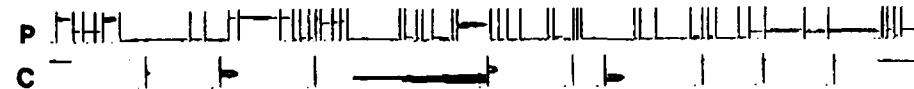
SIZE (NU)	SCATTER PROBE	SIZE (NU)	CLOUD PROBE	SIZE (NU)	PRECIP PROBE
2	1.07E+09	23	1.17E+05	405	1.41E+02
4	5.59E+09	43	7.62E+06	640	4.70E+01
6	1.36E+10	43	1.09E+05	945	1.10E+01
8	1.44E+10	83	7.19E+04	1242	4.02E+00
10	1.04E+10	103	1.56E+04	1539	1.85E+00
12	7.33E+09	122	5.31E+03	1836	4.05E-01
14	4.86E+09	142	3.39E+03	2133	2.61E-01
16	4.24E+09	162	1.87E+03	2430	0.
18	2.88E+09	182	2.68E+03	2727	0.
20	1.40E+09	202	3.32E+03	3024	0.
22	1.04E+07	221	2.43E+02	3321	0.
24	6.29E+06	241	1.81E+02	3618	0.
26	4.05E+06	261	6.74E+02	3915	0.
28	2.70E+06	281	3.61E+02	4212	0.
30	2.00E+06	301	3.13E+02	4509	0.

LWC 1.46E-01 8.84E-03 7.95E-03



TIME: 1918-1920Z
PARTICLE TYPE: Rain

	TEMP C	ALT KM	LWC G/m ³	Z MM+6/MM	DO MU	NT N/m ³	FF
MEAN	-4.3	2.9	.0131	9.4E+01	1092	20728	.02
STANDARD DEVIATION	.1	.0	.0014	5.0E+01	181	6657	.01



PARTICLE SIZE DISTRIBUTION (N/m³-MM)

SIZE (NU)	SCATTER PROBE	SIZE (NU)	CLOUD PROBE	SIZE (NU)	PRECIP PROBE
2	1.24E+08	23	2.75E+04	405	2.04E+02
4	4.24E+07	43	1.02E+06	640	2.80E+01
6	1.12E+07	63	0.	945	1.07E+01
8	3.59E+06	83	0.	1242	5.24E+00
10	1.67E+06	103	1.37E+02	1539	1.20E+00
12	7.04E+05	122	4.99E+02	1836	2.56E+00
14	6.79E+05	142	1.20E+03	2133	5.39E-01
16	3.39E+05	162	9.90E+02	2430	0.
18	1.12E+05	182	2.10E+03	2727	3.15E-01
20	2.24E+05	202	1.12E+03	3024	0.
22	2.24E+05	221	2.52E+03	3321	0.
24	1.14E+05	241	4.72E+02	3618	0.
26	1.12E+05	261	7.48E+02	3915	0.
28	1.11E+05	281	1.02E+02	4212	0.
30	2.24E+05	301	0.34E+02	4509	0.

LWC 3.40E-05 2.16E-03 1.10E-02

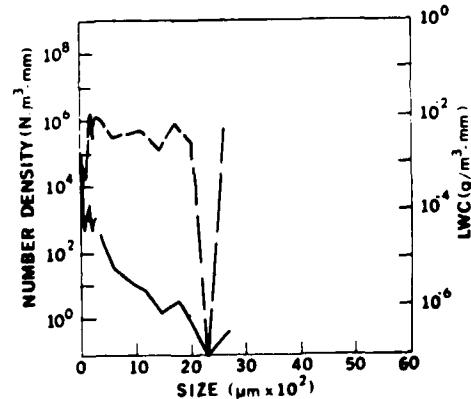
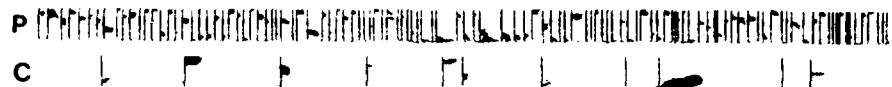


Figure 47. Sample Data From 700 mb - 25 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

TIME: 1912-1934Z
 PARTICLE TYPE: Large Snow
 MEAN
 STANDARD DEVIATION

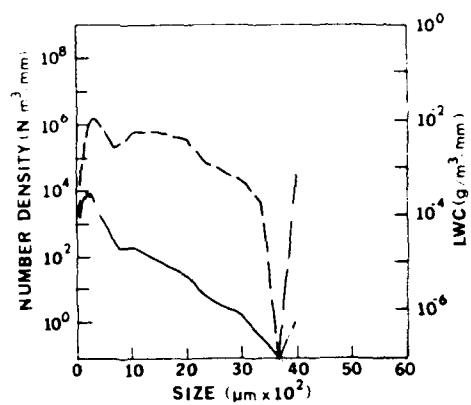
	TEMP C	ALT KM	LWC G/m ³	Z M/m ³	DO HU	NT N/m ³	FF
	-6.5	1.4	.0154	5.7E+00	461	2492	.25
	.1	.0	.0043	2.2E+00	32	298	.04



PARTICLE SIZE DISTRIBUTION (N/m³-MM)

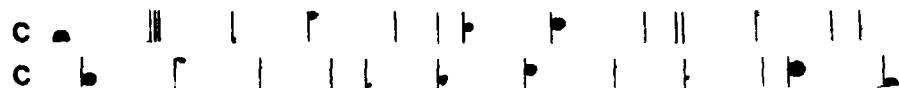
SIZE (NU)	SCATTER PROBE	SIZE (NU)	CLOUD PROBE	SIZE (NU)	PRECIP PROBE
2	1.44E+08	27	1.31E+04	466	1.70E+03
4	1.29E+07	59	3.39E+03	744	1.08E+02
6	6.01E+06	73	1.42E+03	1089	1.04E+02
8	2.75E+06	94	0.	1434	9.39E+01
10	1.42E+06	119	5.22E+02	1779	4.49E+01
12	5.03E+05	142	6.24E+02	2124	2.31E+01
14	3.75E+05	165	7.23E+02	2469	5.48E+00
16	7.53E+05	189	6.40E+02	2814	2.47E+00
18	1.20E+05	211	1.05E+04	3159	1.20E+00
20	1.20E+05	234	7.77E+03	3504	3.17E-01
22	3.00E+05	257	0.56E+03	3849	0.
24	0.	280	9.04E+03	4194	7.42E-01
26	0.	303	7.42E+03	4539	0.
28	2.55E+05	326	6.42E+03	4884	0.
30	0.	349	5.16E+03	5229	0.

LWC 2.34E-05 2.32E-03 1.31E-02



TIME: 1954-1956Z
 PARTICLE TYPE: Rain
 MEAN
 STANDARD DEVIATION

	TEMP C	ALT KM	LWC G/m ³	Z M/m ³	DO HU	NT N/m ³	FF
	1.0	1.4	.0320	3.7E+01	305	9465	.18
	.3	.0	.0075	3.2E+01	58	3561	.13



PARTICLE SIZE DISTRIBUTION (N/m³-MM)

SIZE (NU)	SCATTER PROBE	SIZE (NU)	CLOUD PROBE	SIZE (NU)	PRECIP PROBE
2	1.04E+09	23	0.	405	1.31E+03
4	6.01E+09	47	9.27E+04	646	1.07E+02
6	3.17E+09	62	1.42E+04	945	1.21E+01
8	1.20E+09	83	5.26E+04	1242	1.95E+00
10	4.32E+09	103	5.32E+04	1539	2.60E-01
12	1.69E+09	122	6.22E+04	1826	0.
14	8.12E+07	142	4.43E+04	2133	2.93E-01
16	2.04E+07	162	1.29E+04	2430	1.13E-01
18	1.70E+07	182	2.70E+04	2727	0.
20	9.67E+06	202	2.18E+04	3024	0.
22	6.41E+06	221	1.22E+04	3321	0.
24	6.41E+06	241	1.06E+04	3618	0.
26	5.00E+06	261	6.73E+03	3915	0.
28	2.37E+06	281	5.20E+03	4212	0.
30	3.09E+06	301	4.19E+03	4509	0.

LWC 3.76E-03 1.53E-02 1.67E-02

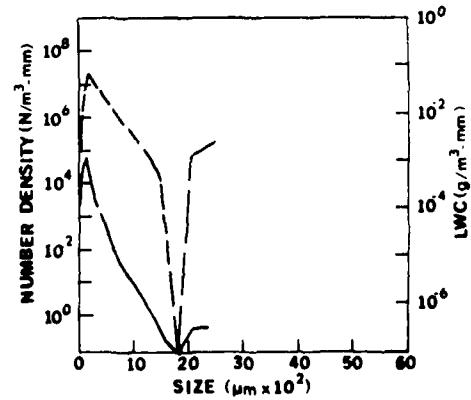


Figure 48. Sample Data From 850 mb - 25 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

7.4 Samples From 26 March 1978

By 26 March, the secondary low in Georgia had brought additional moisture to the lower levels of the storm system. The main system now had reached the east coast and the Atlantic Ocean provided additional moisture. The intensity of precipitation from the system increased as the liquid water content of the clouds increased.

Data from the 400-mb level on 26 March are presented in Figure 49. Liquid water content increased as the number of large particles increased. The Form Factor remained high, which indicated that the particles at this level were still of uniform size. The distribution does show a similarity to the distributions found at this level on 23 and 24 March. All had relatively high Form Factors and low values of liquid water content. The crystal types generally were small snow with some bullet rosettes despite the different synoptic situations.

Data from the 500-mb level on 26 March are shown Figure 50. The difference between the system on 25 and 26 March is more evident at this level. Large snow was present and, as both the 2-D data and particle size distributions show, there were many larger particles at this level on 26 March. The large particles caused a decrease in the Form Factor both from the 400-mb level on both days and the 500-mb level on 25 March. Although the increase in moisture at this level was substantial, the 500-mb data from 23 March show that in a more convective system even more moisture can be found at this level. The 500-mb data showed the greatest variation in Form Factor, maximum particle size, and particle size distribution of any level examined in this report.

The 700-mb level showed the influx of moisture clearly. As Figure 51 shows, the liquid water content at this level was among the highest observed during the series of flights. A large number of particles, combined with the frequent occurrence of large and wet snow, provided an ample amount of moisture that led to the moderate rain observed at the surface. The temperature was about -3°C, thus, the freezing level was still below the aircraft. Unlike the 500-mb level, at this level the liquid water content was greater in the stratified situation on 26 March than in the more convective situation on 23 March.

At the 850-mb level, the aircraft was no longer in solid clouds. Figure 52 shows that rain and water droplets predominated. The influx of warm air led to relatively warm temperatures as compared to those observed on 24 and 25 March at this level. As was the case on previous days, the Form Factor was low at 850 mb indicating a broad range of particle sizes. Secondary peaks, above 3000 μm , helped decrease the value of the Form Factor. The total number of particles had decreased from 700 mb; possibly due to the difference in sampling time and location or to the particles combining into larger drops before reaching this altitude.

This final sampling of the storm system showed the effect of the development of a secondary center and/or the proximity of the ocean. This was most evident at the 700-mb level where the number of particles, particle size, and particle type combined to produce a dramatic increase in liquid water content. Although the storm had reintensified, it had not regained the convective character it had displayed earlier and as a result the 500-mb level was not as strongly affected by the influx of moisture. Although there was an increase in moisture at 500 mb, the increase was much smaller than that observed at 700 millibars.

8. OVERALL DISCUSSION

The four flights made on 23 to 27 March 1978 provided a cross section of the development with time of a large scale system. The flight pattern provided a vertical cross section of the storm. The sampling area for each flight was selected to be north of the main low pressure and with the exception of the first three passes on 23 March, all data were gathered in the northeast quadrant of the system.

During the early stages, the storm consisted mainly of convective activity. This resulted in high liquid water contents in the 500-, 700-, and 850-mb levels. As the storm moved eastward, it became more stratified. The 500-mb level became drier, while moisture, when available, remained at the lower levels where the moisture was entering the storm system. Although some changes were seen at the 500-mb level, there was less change in liquid water content, Form Factor, and particle type there than in any of the lower levels.

TIME: 1606-1608Z
 PARTICLE TYPE: Small Snow
 MEAN
 STANDARD DEVIATION

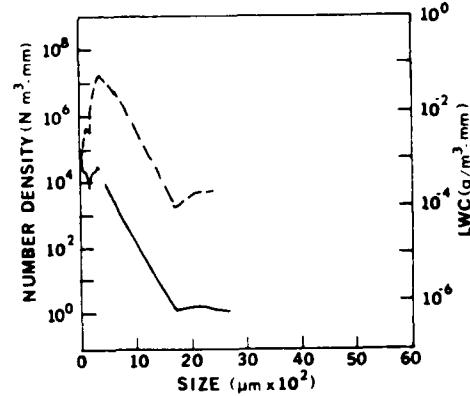
	TEMP C	ALT KM	LWC G/R ^{0.3}	Z MM ^{0.6} /R ^{0.3}	DO MU	NT N/R ^{0.3}	FF
-32.2	7.3	.0274	9.3E-01	226	9700	.56	
.1	.0	.0056	3.7E-01	24	1056	.08	



PARTICLE SIZE DISTRIBUTION (N/M^{0.3}-MM)

SIZE (NU)	SCATTER (NU)	SIZE PROBE (NU)	CLOUD PROBE (NU)	SIZE PROBE (NU)	PRECIP PROBE
2	1.63E+09	27	1.69E+04	466	1.07E+04
4	1.07E+08	50	5.77E+04	744	1.48E+03
6	1.03E+08	73	2.09E+04	1089	1.18E+02
8	7.94E+07	96	2.30E+04	1434	1.25E+01
10	5.95E+07	119	2.29E+04	1779	1.05E+00
12	4.42E+07	142	1.35E+04	2124	1.43E+00
14	2.72E+07	145	9.88E+03	2469	1.10E+00
16	3.49E+07	188	5.72E+03	2814	0.
18	2.12E+07	211	1.32E+04	3159	0.
20	1.30E+07	234	2.14E+04	3504	0.
22	1.10E+07	257	2.14E+04	3849	0.
24	7.73E+06	280	2.12E+04	4194	0.
26	9.13E+06	303	2.53E+04	4539	0.
28	9.03E+06	326	3.17E+04	4884	0.
30	6.94E+06	349	2.44E+04	5229	0.

LWC 1.54E-03 7.48E-03 1.99E-02



TIME: 1616-1618Z
 PARTICLE TYPE: Small Snow
 MEAN
 STANDARD DEVIATION

	TEMP C	ALT KM	LWC G/R ^{0.3}	Z MM ^{0.6} /R ^{0.3}	DO MU	NT N/R ^{0.3}	FF
-32.1	7.3	.0562	3.9E+00	307	9666	.54	
.1	.0	.0037	3.3E-01	1	623	.01	



PARTICLE SIZE DISTRIBUTION (N/M^{0.3}-MM)

SIZE (NU)	SCATTER (NU)	SIZE PROBE (NU)	CLOUD PROBE (NU)	SIZE PROBE (NU)	PRECIP PROBE
2	7.93E+08	27	4.38E+04	466	4.92E+03
4	2.71E+08	50	5.77E+04	744	7.07E+03
6	1.75E+08	73	2.49E+04	1089	6.97E+02
8	1.41E+08	96	3.93E+04	1434	1.07E+02
10	9.45E+07	119	3.48E+04	1779	1.57E+01
12	7.72E+07	142	2.47E+04	2124	1.09E+01
14	4.50E+07	145	2.45E+04	2469	6.83E+00
16	5.82E+07	188	7.17E+03	2814	0.
18	3.51E+07	211	1.55E+04	3159	0.
20	1.05E+07	234	5.72E+03	3504	0.
22	1.54E+07	257	4.10E+03	3849	0.
24	1.43E+07	280	4.05E+03	4194	0.
26	1.27E+07	303	4.35E+03	4539	0.
28	1.05E+07	326	4.13E+03	4884	0.
30	9.11E+06	349	4.29E+03	5229	0.

LWC 2.29E-03 2.45E-03 5.22E-02

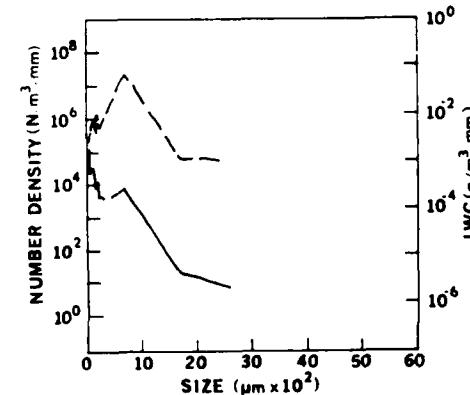


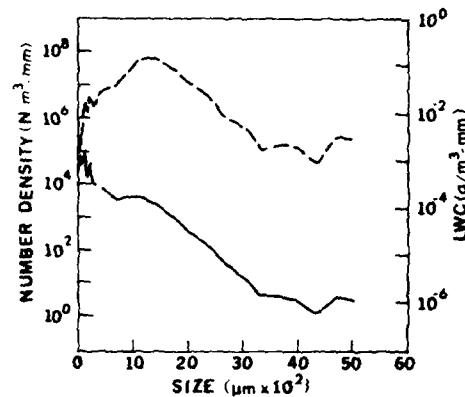
Figure 49. Sample Data From 400 mb - 26 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

TIME: 1632-1634Z
 PARTICLE TYPE: Large Snow
 MEAN
 STANDARD DEVIATION

	TEMP C	ALT KM	LUC G/N ₀₀₃	Z MM ₀₀₃ /N ₀₀₃	DO N	NT N/N ₀₀₃	FF
-19.7	5.6	.1910	8.1E+01	526	15318	.36	
.1	.0	.0193	6.0E+00	0	1860	.08	



PARTICLE SIZE DISTRIBUTION (N/N ₀₀₃ -MM)					
SIZE (MM)	SCATTER (MM)	SIZE (MM)	CLOUD (MM)	SIZE (MM)	
(MM)	PROBE	(MM)	PROBE	(MM)	
2	4.22E+00	17	7.42E+04	466	3.40E+03
4	3.24E+00	50	1.37E+05	746	2.45E+03
6	2.13E+00	72	3.29E+04	1089	3.17E+03
8	1.63E+00	96	5.21E+04	1434	2.07E+03
10	1.22E+00	119	6.49E+04	1779	7.69E+02
12	9.31E+00	142	5.13E+04	2124	2.24E+02
14	6.76E+00	165	3.72E+04	2469	8.37E+01
16	5.75E+00	188	1.29E+04	2814	1.70E+01
18	5.22E+00	211	2.67E+04	3159	9.10E+00
20	3.10E+00	234	1.61E+04	3504	2.33E+00
22	2.48E+00	257	1.27E+04	3849	2.53E+00
24	2.19E+00	280	7.05E+03	4194	1.64E+00
26	2.15E+00	303	7.95E+03	4539	6.07E-01
28	1.89E+00	326	8.26E+03	4884	2.02E+00
30	1.91E+00	349	7.72E+03	5229	1.92E+00



TIME: 1654-1656Z
 PARTICLE TYPE: Large Snow
 MEAN
 STANDARD DEVIATION

	TEMP C	ALT KM	LUC G/N ₀₀₃	Z MM ₀₀₃ /N ₀₀₃	DO N	NT N/N ₀₀₃	FF
-19.4	5.7	.2082	9.66E+01	496	17163	.73	
.0	.0	.0038	1.1E+01	31	1229	.07	



PARTICLE SIZE DISTRIBUTION (N/N ₀₀₃ -MM)					
SIZE (MM)	SCATTER (MM)	SIZE (MM)	CLOUD (MM)	SIZE (MM)	
(MM)	PROBE	(MM)	PROBE	(MM)	
2	1.92E+00	27	1.60E+05	466	5.00E+03
4	2.00E+00	50	7.40E+04	746	4.34E+03
6	2.11E+00	72	5.97E+04	1089	4.08E+03
8	1.67E+00	96	6.71E+04	1434	2.00E+03
10	1.23E+00	119	6.49E+04	1779	6.45E+02
12	9.20E+00	142	5.99E+04	2124	1.80E+02
14	6.49E+00	165	4.92E+04	2469	7.70E+01
16	7.07E+00	188	2.40E+04	2814	1.70E+01
18	8.68E+00	211	3.69E+04	3159	6.67E+00
20	2.79E+00	234	2.00E+04	3504	2.00E+00
22	2.89E+00	257	1.79E+04	3849	7.52E-01
24	2.21E+00	280	9.43E+03	4194	4.91E-00
26	1.79E+00	303	9.03E+03	4539	3.04E-01
28	1.76E+00	326	7.92E+03	4884	9.24E-01
30	1.49E+00	349	6.77E+03	5229	4.12E+00

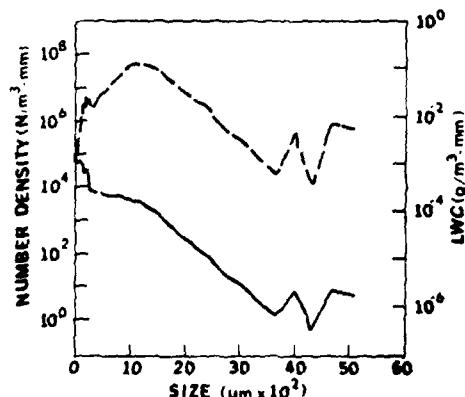
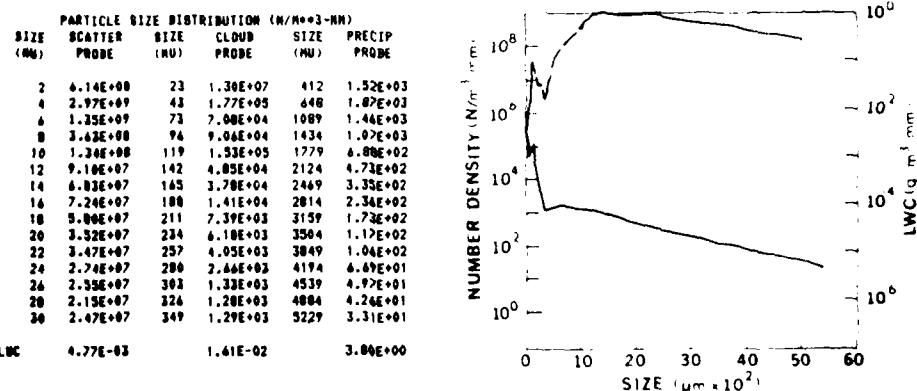


Figure 50. Sample Data From 500 mb - 26 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

TIME: 1710-1712Z
 PARTICLE TYPE: Wet Snow
 MEAN STANDARD DEVIATION

	TEMP C	ALT KM	LWC g/m ³	Z m	DO N/m ³	WT N/m ³	FF
	-2.2	3.0	3.87E-01	8.2E+04	1851	17266	.22
	.1	.0	.3262	1.1E+04	112	2284	.01



TIME: 1722-1724Z
 PARTICLE TYPE: Wet Snow
 MEAN STANDARD DEVIATION

	TEMP C	ALT KM	LWC g/m ³	Z m	DO N/m ³	WT N/m ³	FF
	-2.5	3.0	1.9882	1.8E+04	1427	59315	.12
	.1	.0	.9784	1.1E+04	158	20974	.03

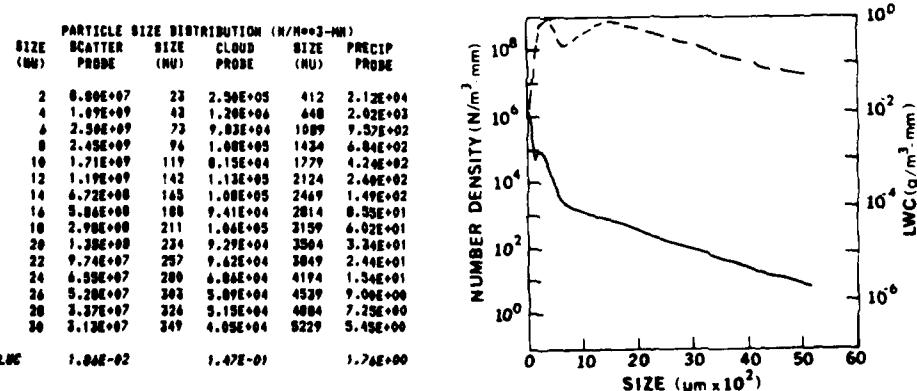
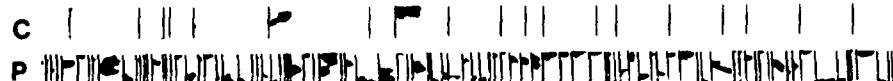


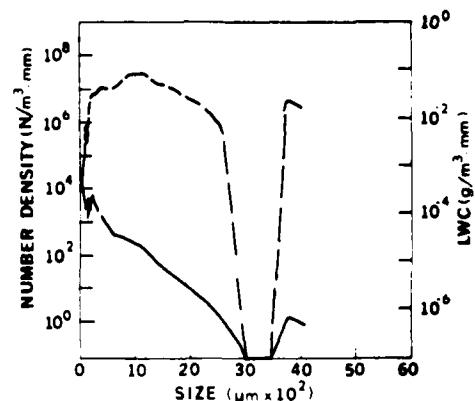
Figure 51. Sample Data From 700 mb - 26 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

TIME: 1740-1742Z
 PARTICLE TYPE: Rain

	TEMP C	ALT KM	LWC G/M ³	Z MM+6/M ³	DO HU	HT N/M ³	FF
MEAN	6.0	1.4	.1422	2.7E+03	1289	2397	.18
STANDARD DEVIATION	.2	.0	.0192	1.2E+03	149	624	.08



PARTICLE SIZE DISTRIBUTION (N/M ³ -MM)							
SIZE (MM)	SCATTER (MM)	SIZE (MM)	CLOUD (MM)	SIZE (MM)	PRECIP (MM)	SIZE (MM)	PROBE
2	3.89E+00	23	4.32E+04	405	1.32E+02		
4	2.06E+01	43	3.44E+04	448	3.07E+02		
6	1.44E+01	63	7.16E+03	945	2.41E+02		
8	3.74E+00	83	5.34E+03	1242	1.18E+02		
10	9.33E+01	103	2.16E+03	1539	3.34E+01		
12	3.32E+01	122	4.30E+03	1836	1.68E+01		
14	2.16E+01	142	5.92E+03	2133	5.78E+00		
16	1.10E+01	162	1.39E+03	2430	2.47E+00		
18	7.43E+00	182	5.28E+03	2727	6.53E-01		
20	4.31E+00	202	2.05E+03	3024	0.		
22	3.12E+00	221	4.77E+03	3321	0.		
24	1.79E+00	241	4.99E+03	3618	0.		
26	1.00E+00	261	2.70E+03	3915	9.19E-01		
28	1.44E+00	281	3.18E+03	4212	5.19E-01		
30	1.66E+00	301	2.82E+03	4509	0.		
LUC	1.36E-03		4.64E-03		1.50E-01		



TIME: 1758-1800Z
 PARTICLE TYPE: Rain

	TEMP C	ALT KM	LWC G/M ³	Z MM+6/M ³	DO HU	HT N/M ³	FF
MEAN	5.6	1.5	.2711	3.6E+03	1469	3461	.16
STANDARD DEVIATION	.3	.0	.0344	1.3E+03	79	847	.08



PARTICLE SIZE DISTRIBUTION (N/M ³ -MM)							
SIZE (MM)	SCATTER (MM)	SIZE (MM)	CLOUD (MM)	SIZE (MM)	PRECIP (MM)	SIZE (MM)	PROBE
2	1.20E+00	23	1.16E+05	405	1.61E+03		
4	1.50E+01	43	7.39E+04	448	4.60E+02		
6	1.90E+01	63	1.61E+04	945	2.07E+02		
8	1.25E+00	83	9.61E+03	1242	1.70E+02		
10	6.57E+00	103	3.42E+03	1539	8.00E+01		
12	3.25E+00	122	3.25E+03	1836	3.95E+01		
14	1.45E+00	142	5.04E+03	2133	1.00E+01		
16	7.43E+01	162	2.70E+03	2430	4.95E+00		
18	2.60E+01	182	4.00E+03	2727	2.12E+00		
20	1.01E+01	202	3.67E+03	3024	7.12E-01		
22	7.45E+00	221	4.48E+03	3321	1.96E+00		
24	2.01E+00	241	4.32E+03	3618	0.		
26	5.17E+00	261	3.55E+03	3915	4.45E-01		
28	2.48E+00	281	3.10E+03	4212	0.		
30	4.80E+00	301	2.79E+03	4509	0.		
LUC	4.10E-03		4.40E-03		2.67E-01		

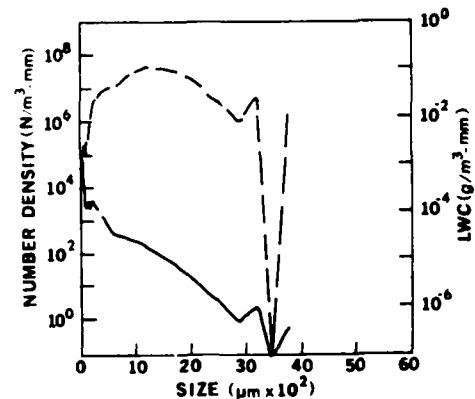


Figure 52. Sample Data From 850 mb - 26 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

Although its derivation seems arbitrary (see Varley⁵) the Form Factor did provide a way of characterizing particle distributions. Figure 53 shows the average of the Form Factors of the two 2-min samples taken at each level on each flight. The convective clouds increased vertical mixing and as a result the first case (23 March) showed the most uniform distribution of Form Factor with altitude. On 24 March, the storm retained convective characteristics and also had the second most uniform distribution of Form Factor. The weak stratiform case on 25 March shows the widest variation. In all cases, the Form Factor decreased between 400 and 700 mb and between 500 and 850 millibars. In general, the Form Factor at higher levels (between 400 and 500 mb) increased with time indicating that the more stratified clouds had a concentration of similar-sized particles. The Form Factor at lower levels (700 and 850 mb) showed no definitive pattern which showed that changes there were more random.

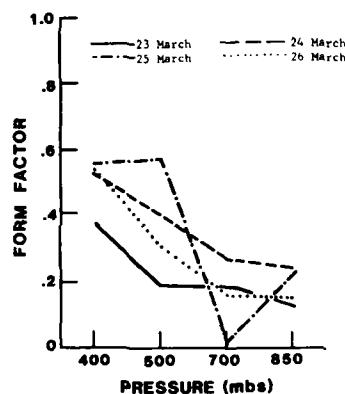


Figure 53. Average Form Factor of 2-min Samples vs Altitude for Each of the Four Sampling flights

In Figure 54, the same method has been used to compare mean particle diameters. In all four cases, the largest particles occurred at the 700-mb level. This was usually the level closest to the melting layer. In all cases, the particle size at 400 mb was small. The mean size was also consistent from sample to sample. This was not the case at 700 or 850 mb as can be seen by examining Figures 37 to 52. As a general rule, the larger the particle diameters, the larger the variability. The larger particles found in the lower levels of the 23 and 26 March cases may be due to the warmer temperatures since warmer air can hold more water vapor. On both of these days, the 850-mb temperatures were 5°C or warmer, while on the other days, 850-mb temperatures were generally below 0°C.

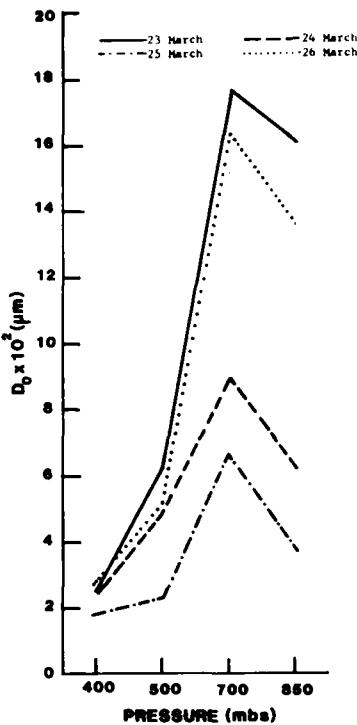


Figure 54. Average Particle Size During 2-min Samples vs Altitude for Each of the Four Sampling Flights

These two quantities illustrate the general tendency of a more consistent cloud above 20,000 ft during the life of the storm, while larger changes in crystal type, density, size, and structure occurred at lower levels. Additionally, the higher level clouds tended toward enhanced particle distributions (see Houze et al⁸), while suppressed distributions were more common at lower levels. Sublimation at higher levels and aggregation at lower levels could give rise to this result.

In effect, there was a tendency toward a uniform type of particle distribution along the vertical axis in the case of a convective storm. The stronger vertical currents caused a more even distribution of particles with altitude. Form Factor and liquid water content varied less from level to level on 23 March than on 25 or 26 March.

9. CONCLUDING COMMENTS

The storm of 23 to 27 March 1978 provided an excellent example of a developing mid-latitude cyclone. The data provided by the MC-130E provide an in depth, detailed look at the development of the storm; the microphysical development of the clouds in the system.

This was a good example of a fairly intense large scale storm. Although the data presented represent only a small sample of the clouds associated with the storm, some essential features of the storm system were sampled, described, and characterized. The fine scale, microphysical data delineate regions dominated by sublimation or aggregation. Future studies of the onset of aggregation and its causes could reveal the potential for advancing or delaying aggregation. Any control in the onset of aggregation would modify the ground precipitation patterns.

References

1. Varley, D. J. (1978) Cirrus Particle Distribution Study, Part 1, Air Force Surveys in Geophysics No. 394, AFGL-TR-78-0192, AD A061485.
2. Knollenberg, R. G. (1970) The optical array: An alternative to scattering or extinction for airborne particle size determination, J. Appl. Meteorology, 9:86-103.
3. Knollenberg, R. G. (1975) The Response of Optical Array Spectrometers to Ice and Snow: A Study of Probe Size to Crystal Mass Relations, AFCRL-TR-75-0494, AD A020275.
4. Knollenberg, R. G. (1976) The Response of Optical Array Spectrometers to Ice and Snow: A Study of 2-D Probe Area-to-Mass-Relationships, AFGL-TR-76-0273, AD A034741.
5. Varley, D. J. (1980) Microphysical Properties of a Large Scale Cloud System, 1-3 March 1978, ERP No. 690, AFGL-TR-80-0002, AD A083140.
6. Chin, D., and Hamilton, H. D. (1979) Synoptic Analysis Case 2, 23 March 1978, AFGL-TR-79-0007, AD A065555.
7. Marshall, J. S., and Palmer, W. Mck (1948) The distribution of raindrops with size, J. Meteor. 5:165-166.
8. Houze, R. A., Hobbs, P. V., Herzegh, P. H., and Parsons, D. B. (1978) Airborne measurements of the size distributions of precipitation particles in frontal clouds, Preprints of Conf. on Cld. Physics and Atmos. Elect., American Meteorological Society, Issaquah, WA, pp 168-172.
9. Plank, V. G., Berthel, R. O., and Barnes, A. A. (1980) An improved method for obtaining water content values of ice hydrometeors from aircraft and radar data, J. Appl. Meteorology, 19:1293-1299.
10. Berthel, R. O. (1980) A Method to Predict the Parameters of a Full Spectral Distribution From Instrumentally Truncated Data, ERP No. 689, AFGL-TR-80-0001, AD A085950.

References

11. Plank, V.G. (1977) Hydrometeor Data and Analytical-Theoretical Investigations Pertaining to the SAMS Rain Erosion Program of the 1972-1973 Season at Wallops Island, Virginia. AFGI/SAMS Report No. 5. ERP No. 603, AFGL-TR-77-0149, AD A051193.
12. Byers, H. R. (1965) Elements of Cloud Physics, University of Chicago Press.
13. Dyer, R. M., Berthel, R.O., and Izumi, Y. (1981) Techniques for Measuring Liquid Water Content Along a Trajectory, ERP No. 233, AFGL-TR-81-0082, (in press).

Abbreviations

AFB	Air Force Base
AFGL	Air Force Geophysics Laboratory
Ci	Cirrus
Cu	Cumulus
DO	Medium Volume Diameter
EWER	<u>E</u> vaporate the <u>W</u> ater that aggravates <u>E</u> rosion on <u>R</u> eentry
FF	Form Factor
GOES	<u>G</u> eostationary <u>E</u> nvironmental <u>S</u>
Hdg	Aircraft Heading
IAS	Indicated Airspeed (knots)
INS	Inertial Navigation System
km	Kilometer
LWC	Liquid Water Content
m	Meter
mb	Millibar
McIDAS	Man-Computer Interactive Data Access System
mi	Miles
mm	Millimeter (= 10^{-3} meters)
nm	Nautical Miles
NT	Number Density; Total Number of Particles per Cubic Meter
OAT	Aircraft Outside Air Temperature (degrees, Celsius)
PMS	Particle Measuring Systems, Incorporated

Sc	Stratocumulus
St	Stratus
TAS	True Airspeed (knots)
TT	Rosemount Total Temperature
Vis	Visibility
Z	Reflectivity or Greenwich (Universal) Mean Time
μm	microns ($= 10^{-6}$ meters)
1-D	One Dimensional PMS Probe
2-D	Two Dimensional PMS Probe

Appendix A

Mission Director's Comments

Excerpts from the written notes and those recorded on the voice tape by the Mission Director, Capt Donald Cameron, are presented here. Remarks in parentheses are additions by the author based on the voice tapes, nose camera film, and photographs taken by the Mission Director.

All temperatures are those read from the aircraft outside air temperature indicator. These are generally warmer than the actual air temperature. The Rosemount Total Temperature readings are included in the listings found in Appendix B.

Aircraft position is reported as "Latitude/Longitude" and is given in degrees and minutes.

Winds are reported as "Direction in degrees/speed in knots".

Flight Notes From 23 March 1978 - Mission 78-10

<u>TIME (Z)</u>	<u>COMMENTS</u>
19:10:00	(Rain reported by crew while preparing for takeoff from Kirtland AFB.)
19:11:51	(Thunderstorm with hail observed by aircrew.)
19:25:53	Takeoff from Kirtland AFB, New Mexico.
20:24:17	12 mi West of Amarillo.
20:28:00	Most clouds in the area look solid with good vertical development.
20:29:00	Setting up a leg between Dalhart and Texico.
20:31:05	Ran out of clouds, about to go back into them.
20:32:47	Clouds now very thick; at Amarillo, there weren't any clouds.
20:34:14	Altitude: 23,600 ft; Heading: 286; Winds: 035/21; TAS: 248; IAS: 170.
20:36:35	Going into clouds soon. Coming to tail clouds 8-9,000 ft above us. Moderate snow, occasional light turbulence.
20:39:00	<u>BEGIN PASS 1:</u> Alt: 23,700 ft; 40 NM east of Dalhart. Heading 272 and turning. INS Winds: 183/28 - 0.3 to 0.3 mm particles Max = 0.6 mm.
20:40:37	Gray outside from top to bottom. TAS 219.
20:41:14	116 deg /33 nm from Dalhart.
20:41:43	0.3 mm particles - IAS 150, TAS 220, sky still gray. Horizontal visibility 1 nm. Occasional light turbulence.
20:43:07	Passed a brief break in the clouds. Particle sizes 0.2 to 0.4 mm; sizes gradually increasing. Plates are common.
20:45:07	Can see a layer below. Still light updates. Ci has thinned out; Filaments are going by.
20:47:18	Sc undercast with towering Cu coming through it.
20:50:00	<u>END PASS 1.</u> Beginning a spiral descent, undercast Sc, Cu popping through. Clear above.
20:55:54	Coming under a cloud deck.
20:56:58	Position: 35.57/102.26. Under cloud band.
20:58:00	<u>BEGIN PASS 2.</u> Position: 35.54/102.22, Wind 243/22; 15 nm from Dalhart.
21:00:35	Solid undercast. Fairly solid overcast with CU activity.
21:01:52	Nothing on snowstick. Gray all over.
21:04:46	Broke out of clouds. Solid undercast. Sc and Cu.
21:06:37	Back into clouds Spotty snow, many sizes -from 0.2 to 2.0 mm on snowstick.

Flight Notes From 23 March 1978 - Mission 78-10 (Cont)

<u>TIME</u>	<u>COMMENTS</u>
21:08:13	18 nm from Amarillo. Larger snowstick activity, about 3 mm.
21:09:52	Good 2.0 mm updates. It is gray out; can not see up or down. Can locate the sun only by its brightness.
21:11:04	Moderate snow. Light turbulence. Sizes 0.6 - 0.7 mm to 2.0 mm.
21:12:06	Hdg 130; six miles from Amarillo.
21:14:00	<u>END PASS 2.</u> Large snow - moderate. Particles as big as 3.0 to 4.0 mm.
21:26:00	In clear air.
21:26:26	Weather has changed rapidly. Since arriving in the area, the system has moved from west of Amarillo to Amarillo to east of Amarillo.
21:28:10	Clouds are now past Amarillo; nothing to the west.
21:30:00	<u>BEGIN PASS 3.</u> 9,880 ft. Wind 262/14. Between layers; Ci and middle cloud above. Undercast below, position 35.40/105.57.
21:31:43	Still between layers. Horizontal bands to the side.
21:33:00	Between layers. 1500 feet above the lowest layer. Not getting any droplets. 2 to 3 thousand feet below bases of upper layer.
21:34:22	Getting into haze. Sun not visible. Nothing on probes or snowstick.
21:35:37	Position: 35.42/101.37. Getting some fallout from cloud above. Can see virga.
21:38:42	Horizontal visibility is now 15 miles. Decreasing as we go into underhang from clouds. Wet snow - particle sizes 2 to 3 mm - on snowstick.
21:39:42	Completely in cloud. OAT = +4. In a turn. TAS - 180.
21:40:27	Snow grains - 2 to 3 mm. Some melt, others do not.
21:41:15	Breaking into a clear area. Position: 35.40/101.14
21:42:00	<u>END PASS 3.</u>
21:42:28	Enroute to NE Oklahoma. (Enroute to the next area aircraft climbed to 23,000 ft. At that altitude, it was in the clear until 2200Z.)
22:00:00	(From here until arrival at the next area, aircraft was in and out of clouds.)
22:40:40	<u>BEGIN PASS 4.</u> 23,000 ft. OAT - 20 IAS 148 in cloud - have been for a while A little icing on wingtips.
22:41:22	Heavy particles 0.4 to 0.8 mm on snowstick.
22:43:20	Crystals appear to melt. Maximum size 1 mm - getting into heavier precipitation.
22:44:37	Hdg 200. Pos. 35.53/95.47. Wind 233/34 strictly in cloud.
22:45:38	Little icing on the wing. Can not see filaments - only gray.

Flight Notes From 23 March 1978 - Mission 78-10 (Cont)

<u>TIME</u>	<u>COMMENTS</u>
22:46:22	Consistent cloud. Size of particles 2 mm, 0.5 mm width. Clouds are black to gray.
22:48:37	Still in cloud. Most particles are 0.3 to 0.8 mm. Maximum particle size is 1 mm.
22:49:08	Possibly a little lighter out. Still gray. Hdg 005. Pos 36.13/95.39. Wind 231/39 TAS 224, IAS 151. Small counts on Precip probe.
22:50:46	In cloud. Particles a bit smaller - 0.3 to 0.5 mm. Wing visible. Horizontal Vis 1/2 mi. No ice on windsheild. Alt 23.6 m Had 002.
22:52:37	Stick not icing as before. Particle distribution is bimodal. Peaks at 0.2 and 0.8 mm.
22:54:25	Sun very dimly visible through clouds above. Ice on edge of wing.
22:56:23	A little turbulence. Particles going to 2.0 mm.
22:58:49	Turbulence decreasing. Particles 0.3 to 2.0 mm. Still in gray clouds.
23:00:25	Particle size getting a bit smaller.
23:02:00	<u>END PASS 4.</u> Will descend to 18,000 ft, then turn around to start pass.
23:06:26	(Navigator notes storms about 20 NM out.)
23:09:47	In cloud. 18,300 ft alt. Deviating to avoid thunderstorms.
23:11:07	Snow - up to 3 mm. Snowstick quickly covered with snow.
23:12:50	Position 36.43/95.29.
23:13:30	Particles now smaller - about 0.3 mm.
23:15:22	Back to larger snow, almost wet. About 0.8 mm. 6-sided crystals.
23:16:23	Position 36.34/96.25. Wind 238/24.
23:19:07	Still gray. Hdg 200. Wind 242/27. 47 nm from Okmulgee, Oklahoma.
23:19:54	Snowstick range 0.4 to 1.0 mm.
23:20:32	Patches of small snow alternate with large ones.
23:22:05	Altitude change to 17,100 ft beginning at 2323Z. Position 36.15/95.35. Wind 240/23 - have picked up.
23:24:23	Sizes of particles are larger. More at 1-2 mm. 60% still 0.3 to 0.4 mm.
23:25:25	Max particle size 1.5 mm Min size 0.4 mm.
23:26:17	Some particles are 3.0 mm. No turbulence. Alt 17,200 ft. 25 mi from Okmulgee. Position 36.05/95.40, Wind 220/24.
23:28:35	Snowflakes visible. Max size 2 mm. Occasional light turbulence.
23:29:16	Size dropping off to 0.9 mm.

Flight Notes From 23 March 1978 - Mission 78-10 (Cont)

<u>TIME</u>	<u>COMMENTS</u>
23:32:47	Big particles on 2D, but the recorder had stopped.
23:33:00	<u>END PASS 5.</u>
23:36:00	Lightning just ahead. Position 35.41/95.51. Winds 218/22.
23:43:00	<u>BEGIN PASS 6.</u>
23:43:35	Getting large wet snow. 3 to 4 mm sizes. Occasional light turbulence.
23:45:07	Altitude 9,900 ft. Wet snow. Particles as large as 5.0 mm.
23:46:28	Position: 36.08/95.40. Wind 220/15.
23:47:10	No definitions of clouds just uniform gray up and down, OAT +4, TAS 174, Hdg 008. Pos. 36.13/95.38. Wind 213/27.
23:48:10	Still wet snow, 2 to 3 mm. Melting as it hits the stick. Intensity: light.
23:50:03	Gray, wet snow. Sizes a bit smaller. 3 mm max. TAS 187 Hdg 012.
23:51:20	Particles a bit bigger—to 4.0 mm.
23:53:52	Wet snow melts when hitting the stick. Diameters to 6 mm.
23:55:45	TAS 184. Position: 36.37/95.26.
23:56:30	Data still very consistent.
23:57:07	(More lightning observed by crew)
23:57:37	More intense 2 to 3 mm wet snow. IAS 150.
23:58:55	Moderate rain, occasional snow. Light turbulence. Position: 36.48/95.16. Wind 300/09.
00:00:38	Wet snow then rain, lightning to the right.
00:02:30	Occasional light turbulence. Wet snow. 2 to 3 mm occasionally heavier.
00:02:45	Gray outside. Consistent at all levels.
00:03:20	Clouds have appeared below. CU type. The first time in awhile that structure is visible.
00:05:00	<u>END PASS 6.</u> Wet snow; uniform gray.
00:18:23	In rain. Good streaks. Alt 5,000 ft.
00:19:30	<u>BEGIN PASS 7.</u> Alt 4.9 m. Hdg 212. Light rain.
00:20:08	Position 36.44/95.21. Wind 161/04. Small clouds to the side. Clouds above a little lighter than before.
00:20:41	Lower layer tops 3000 ft, solid undercast. Also solid overcast. Tops are 6000 ft to the west. Rain intensity has decreased.
00:22:57	In light rain between layers. Sc, St below; some Sc at 5 to 6 thousand feet.
00:23:38	Getting rain from the layer above.

Flight Notes From 23 March 1978 - Mission 78-10 (Cont)

<u>TIME</u>	<u>COMMENTS</u>
00:24:55	Visibility decreasing. Still in light rain. TAS 165.
00:27:30	Still in light rain. Going through the base of a cloud.
00:30:35	Cu clouds; ground visible. Low broken St 700 ft above the ground. Broken layer 4 to 7 thousand feet. Still in continuous light rain.
00:32:36	Hdg 200. Alt 4,800 ft. TAS 164 Position: 6.14/95.39. Wind 160/04. Starting to see clouds and particles going by.
00:33:23	Light to moderate rain. In and out of cloud. Tops 6M.
00:34:00	Back into cloud. Occasional light turbulence.
00:36:57	Rain is a bit lighter. Ground visible. Out of clouds. Broken St below at an altitude of 2500 to 3500 ft.
00:37:40	Still getting light rain. Horizontal visibility 4 nm. Alt 4700 ft.
00:40:00	<u>END PASS 7.</u> TAS 160; IAS 149.
00:43:32	Climbing to 19,000 feet.
01:36:00	Land at Little Rock AFB, AR.

Flight Notes From 24 March 1978 - Mission 78-11

<u>TIME</u>	<u>COMMENTS</u>
17:46:20	Takeoff from Little Rock AFB, AR.
17:49:00	(Aircraft is climbing through low cloud layer.)
19:43:00	<u>BEGIN PASS 1.</u> In cloud. Heading 246. Position 41.10/89.40. True Airspeed 220. Indicated Airspeed 150 knots.
19:43:55	Sun a little brighter now. Light but increasing activity on the snowstick. 0.8 mm average.
19:44:41	Altitude, 23,400 ft. IAS 145, TAS 213, Outside air temp -19.
19:45:35	Position 41.07/89.49. Wind 166/24.
19:46:35	Snowstick particles are smaller - 0.2 to 0.3 mm. Intensity is light.
19:48:37	Snowstick particles are now round. Cloud has filaments. A bit of blue is visible. Tops appear 3,000 ft up. Horizontal visibility 2 miles. Gray below.
19:49:21	Very little evidence of icing.
19:50:29	Sky almost blue, but in a wall of clouds. Clouds still extend 2 to 3,000 feet up.
19:52:11	Clouds are a bit lighter than yesterday.
19:54:42	Looks like it is getting thinner above.
19:55:50	Jet passed; no contrails. Gravish above. No distinction of cloud below.
19:58:46	Particle size increasing. Intensity moderate. Stick fills up in 5 to 6 seconds. Size 0.4 to 0.5 mm. Max 1.0 mm.
20:00:17	Intensity now light to moderate. 40.56/91.02. Wind 129/15. TAS 223 OAT -20 to -21.
20:01:10	Size more consistent. Intensity is heavier.
20:13:25	Position 40.34/96.19. Wind 120/31. Probably going through the tops of Cu. Nothing on radar.
20:04:21	Snowstick particles a bit larger - average size 0.8 mm.
20:04:39	Particles now a bit smaller - roundish - 0.9 mm max; width 0.4 mm.
20:05:35	Starting to break out. Patch ahead.
20:07:00	<u>END PASS 1.</u> Clouds to the right; open to the left. Position 40.51/91.39 - is 10 nm after leaving clouds.
20:11:22	Level and in clouds at 40.50/91.57.
20:15:00	<u>BEGIN PASS 2.</u>
20:15:21	40.54/91.57. Between layers. Hdg 080. Wind 134/13.
20:16:52	Bright above. Ci well above.
20:17:52	Alt. 18,300. Still between layers.
20:19:27	Round snow - may be icing up. Flakes are 1 to 2 mm.

Flight Notes From 24 March 1978 - Mission 78-11 (Cont)

<u>TIME</u>	<u>COMMENTS</u>
20:20:32	Completely overcast. Now in clouds. Alt 18,300.
20:22:37	Sun briefly visible. 0.3 mm particles are probably fallout from Ci.
20:23:47	41.00/91.22. Wind 156/18. Very light snow. Can see clouds passing.
20:28:22	In and out of Cu. Light Chop. Sun visible. Thin Ci overcast above. Light snowstick activity.
20:29:21	At 18,000 ft. Horizon has disappeared.
20:30:12	Light Chop. Particles are a bit larger - to 0.6 mm.
20:31:00	Horizon visible to left; not to right. Snowstick icing up.
20:32:12	Back in clouds. Light snowstick activity. Sizes 0.6 to 0.7 mm.
20:33:57	Between layers.
20:35:40	In clouds. Looks like large snow. 1 to 2 mm.
20:36:47	Position: 41.06/90.26. Wind 185/32.
20:39:47	Can see horizon. Can see sun. Snowstick particles 1 to 2 mm. Occasionally 3 mm.
20:42:36	Smaller, elongated particles on snowstick. 1 mm long; 0.4 mm wide.
20:44:00	Particles more elongated. Narrow, bunched up snow, some ice on probes.
20:45:10	18,600 ft. 2.0 mm particles on snowstick. Sun appears as a bright spot. Overcast above and below. Wind 201/18.
20:46:00	<u>END PASS 2.</u> Position 41.10/89.43.
20:56:35	(Winter storm advisories are up for IN, IL, OH).
20:57:30	<u>BEGIN PASS 3.</u> 9,600 ft. Gray outside. Winds 133/29, Pos. 41.07/90.10 OAT +1, Dew Pt. -3. Snowstick iced up.
20:58:37	Wet, melting snow.
20:59:30	Rain and snow mixed. Particles to 3 mm. Alt 9700 ft, Hdg 248.
21:00:07	33 nm from Bradford. Most particles are droplet size.
21:00:48	Rime type icing. Easy to remove. Snow occasionally visible.
21:01:27	41.04/90.23. OAT = -1. Dew Pt -2.7 Occasional snow, but mostly water. Size 0.8 mm. Stick freezes.
21:03:20	Rime icing on windshield.
21:05:03	Little snow now - mostly rain.
21:06:33	41.02/90.44. Wind 118/31. TAS 174. IAS 150; bottom windows are covered with ice.
21:11:01	More rain and rime icing. Flakes to almost 4.0 mm; large snow.
21:12:30	Solid looking 3 mm globs. Also wet snow. IAS 150. TAS 172. Alt. 9,700.

Flight Notes From 24 March 1978 - Mission 78-11 (Cont)

<u>TIME</u>	<u>COMMENTS</u>
21:15:46	Well formed 2 to 3 mm snowflakes.
21:17:00	OAT is just above 0.
21:18:10	Alternating between wet and large snow.
21:19:57	More icing, wet snow 2-3 mm max. Most flakes about 1 mm.
21:21:41	Hdg 250. Dew Pt -4.0.
21:25:00	<u>END PASS 3.</u>
21:29:58	Alt 7,200, observing big, wet snow.
21:30:59	Flight has been smooth.
21:32:57	Still getting wet snow. Icing on probes.
21:36:00	<u>BEGIN PASS 4.</u> In wet snow at 5,000 ft.
21:37:18	Sizes 2 to mm. Alt 4,700 ft. TAS 159, OAT = +2, IAS 150.
21:40:25	Often in precipitation.
21:41:55	Dew Pt 0, OAT +2. Occasional snowflakes, but mostly rain.
21:43:30	Rain and snow mixed.
21:44:38	TAS 159. Alt 4,700. Hdg 078. 40.56/91.26. OAT +3.
21:46:22	More wet snow. Sizes range from 1 to 2 mm.
21:48:00	Sizes of flakes are increasing. One was 5.0 mm.
21:49:11	Rain and snow mixed.
21:54:40	Alt 4,700 ft. TAS 159. OAT = +3. Position: 40.69/91.01. Wind 092/38. Wet snow. A trace of icing. Snow diameters 0.3 to 3.0 mm.
21:57:55	Snow shapes are irregular. OAT +3.
22:00:00	41.01/90.48. Dew Pt = -0.7. TT +3. <u>END PASS 4.</u>
22:05:27	Climbing to 17,000 ft for the flight back to Wright-Patterson AFB.
23:02:40	Ice forming on the leading edge of the wing.
23:03:30	(Crew can see the ground.)
23:40:00	Land at Wright-Patterson AFB, OH.

Flight Notes From 25 March 1978 - Mission 78-12

<u>TIME (Z)</u>	<u>COMMENTS</u>
16:56:00	(Pilot notes low ceilings at Wright-Patterson AFB.)
17:05:25	Takeoff from Wright-Patterson AFB, OH.
17:34:00	(Ci; changes from overcast to scattered.)
18:00:00	<u>BEGIN PASS 1.</u> Between layers. Ci and halo above. Ci about 4 to 5,000 ft up.
18:00:41	On snowstick, light activity. Looks like small snow.
18:01:12	TAS 219. Hdg 109. 75 mi from Bradford, PA.
18:02:00	Position 41.44/80.15. OAT -20. Wind 238/34. Vis 3 mi in cloud and haze. Top of lower cloud layer visible.
18:03:48	Altitude: 25,000 ft.
18:04:00	Totally gray ahead, but currently in an open area.
18:05:30	Clouds at flight level. Small snow on the stick - 0.4 to 0.5 mm. 2-D shows elongated particles.
18:07:42	Halo still visible. Hard to see lower clouds. Snowstick activity has decreased. Visibility has improved.
18:16:23	Alt 23,600. IAS 150. TAS 219. OAT -21. 44.78/78.56. Wind 234/39. Snowstick -0.2 mm. Activity is light.
18:18:57	41.44/78.44, IAS 150. Can see texture of clouds above. Snowstick 0.2, occasionally 0.5 mm.
18:20:30	<u>END PASS 1.</u> Clouds today are thinner and more stratified than in previous days.
18:27:00	Level. <u>BEGIN PASS 2.</u> Alt 18,300 ft. TAS 206. Position: 41.46/78.58.
18:28:30	Wind 218/34. Snowstick particles up to 2 mm. Average 0.8 mm.
18:29:19	Uniformly gray.
18:30:37	41.46/79.10. 0.8 - 0.9 mm. Occasionally 1.5 mm. Intensity back to light. Most flakes are round. A few are elongated.
18:31:34	Halo above.
18:32:38	Lower tops 9 to 10,000 ft. Blue patch above.
18:33:33	Little on snowstick.
18:34:33	Overcast 3,000 ft above.
18:39:17	A little bounce. Can see clouds below. Contrails overhead. Can see through Ci. Looks grayer ahead.
18:40:20	Entering clouds. Snow stick has 0.4 to 0.5 mm particles. Alt 18,300 ft. More clouds ahead.
18:40:52	41.46/79.50. Wind 224/28. Snowstick 0.2 - 0.3 mm.

Flight Notes From 25 March 1978 - Mission 78-12 (Cont)

<u>TIME</u>	<u>COMMENTS</u>
18:42:14	Stratified clouds to the right. 3 layers of Ac and As.
18:43:12	2000 ft below solid Ci. Clouds lower to the left. Few clouds to the south.
18:44:20	Will terminate pass early due to lack of clouds at 18,000 ft.
18:46:00	<u>END PASS 2.</u> 41.47/80.09. Wind 224/28.
18:47:12	Clouds are light-between layers. Undercast left. 3000 ft below.
18:48:45	Open sky south. Alt 15,700. Undercast 2000 ft down.
18:51:00	Entering cloud tops at 13,500 ft. OAT -2.
18:52:02	Snowstick is freezing up. Mostly rain.
18:53:26	In freezing rain.
18:57:00	<u>BEGIN PASS 3.</u> Much cloudiness at 10,000 ft. Dew Point +1.9. Mostly rain. Occasional snowflakes. Alt 9,600.
18:59:37	Water streaming off the window.
19:03:00	Freezing rain reported in Maryland.
19:03:42	OAT +2. TAS 173. Position: 41.47/80.12. Wind 230/24. Can not see texture of clouds. Visibility 1/2 mi. Rime icing on wing.
19:09:10	Icing, but few particles on the snowstick.
19:10:50	Altitude 9,600 ft. Ice on intakes.
19:11:34	In rain. Icing coming from precipitation. More icing than yesterday.
19:13:26	TAS 171. OAT 0. 41.48/79.33 241/21. Icing: poor visibility, definitely in cloud. No flakes hit the snowstick.
19:19:20	Ice readily forms; is easy to knock off. Still raining. Occasional flakes. Alt. 9,550 ft. Hdg 098.
19:23:00	<u>END PASS 3.</u> Terminated early due to aircraft icing problems.
19:28:27	Ground visible. Snow still there.
19:31:00	<u>BEGIN PASS 4.</u> 4,700 ft. Back in large snow.
19:32:05	Snow 2 to 3 mm. down to 0.8 mm. Ground with snow visible. OAT -2. TAS 154. 4,600 ft. Hdg 270.
19:32:44	Position: 41.44/78.05 Wind 130/47. TT -5. Light snowstick activity - elongated Max 2.0 mm.
19:33:34	Fracto Cu below. Bases less than 1000 ft above the ground.
19:38:20	Ground visible. Supercooled water. More clouds below.
19:39:11	Visibility 1/4 mi. Continuous clouds above.
19:43:33	Light turbulence.
19:44:30	Now getting pure rain. In cloud, ground not visible.
19:45:37	Still getting icing on props and probes.
19:46:35	In and out of clouds. Overcast solid above. Only rain on snowstick.

Flight Notes From 25 March 1978 - Mission 78-12 (Cont)

<u>TIME</u>	<u>COMMENTS</u>
19:47:47	Winds dropped to 34 kts.
19:55:00	Light rain. TAS 157. Alt. 4,700. Hdg 275. OAT +4.5.
19:55:49	42.00/78.18. Wind 157/17.
19:57:50	Still looks like rain - light streaking. IAS 150. TAS 160. PAT +4. Pos. 41.43/80.23. Wind 156/17.
19:59:33	Ground and low clouds below. Rain at Acft level. 41.43/80.33.
20:00:00	<u>END PASS 4.</u>
20:40:00	(Between layers.)
20:48:06	(Crew observes rain.)
20:55:30	Final comments. Not as much cloudiness as on previous flights. Much icing at the lower levels. Temperature was constant with altitude at +2 to +4. Rain and snow were mixed at lower levels.
21:02:25	Land at Wright-Patterson AFB, OH.

Flight Notes From 26 March 1978 - Mission 78-13

<u>TIME (Z)</u>	<u>COMMENTS</u>
14:44:40	Takeoff from Wright-Patterson AFB (Into Ragged Sky).
14:47:46	(On top of Sc deck.)
15:24:00	(Aircraft moves below Ci shield.)
15:35:38	(Aircraft goes into cloud.)
16:01:00	Nice Halo. Contrail through Ci. Nothing below. Layer above. Gray on both sides.
16:06:00	BEGIN PASS 1. 23, 600 ft. Outside Air Temp = -20. Dew Pt = -30.
16:07:45	Position 40.29/76.40
16:08:46	Can barely see a halo. Winds 260/73. Sun is bright. In light precipitation. No definition of cloud. Particle length 1 mm. Width 0.4 mm.
16:09:36	Intensity is increasing. OAT -20.
16:11:00	Intensity still light. Max Particle 1.5 mm; most are smaller. -0.2 mm.
16:12:51	OAT -20. TAS 222. Particle sizes 1.0 to 0.4 mm. Sun is bright - with halo. Below - solid clouds. IAS 150.
16:13:37	Position: 40.48/76.15. Wind 199/70.
16:14:33	Particle distribution on snowstick is bimodal. Peaks at 0.4 mm and 1.0 mm.
16:16:38	Position: 41.01/76.00. Wind 204/74. Larger particles are round; 1 mm in diameter.
16:17:40	Now particles are smaller. Avg. 0.7 mm.
16:20:52	Nice halo. Sun too bright to look at.
16:22:40	Flakes smaller. Winds 210/65.
16:23:00	<u>END PASS 1.</u>
16:24:30	Descending to 18, 300 ft.
16:31:00	<u>BEGIN PASS 2.</u> Alt 18, 300. IAS 150 kts.
16:31:40	TAS 202. OAT -10. Snowflakes 2. to 3. mm. Same on precip. Intensity light to mod.
16:32:30	Some particles 0.8 mm. Pos. 41.12/75.49. Winds 202/36.
16:33:27	Wind 213/28. Snowstick - 2 mm avg. Some about 1 mm.
16:35:50	1.0 to 2.5 mm on stick. Light snow. Some elongated.
16:37:16	Breaks in clouds; snow becoming less intense.
16:39:00	Position: 40.48/76.08. Wind 248/14, speed diminishing. Snowflakes light - 1 to 2 mm sizes, some smaller.
16:44:06	Light-Mod. precip. 2 to 3 mm, or smaller. Sometimes they melt on stick.

Flight Notes From 26 March 1978 - Missi 78-13 (Cont)

<u>TIME</u>	<u>COMMENTS</u>
16:45:10	Clouds consistent; grayer toward the front. Can almost see the sun.
16:46:00	Halo still visible. Clouds are stratified, tops are at 15,000 ft.
16:48:33	Few breaks in Ci. Smaller flakes, avg 0.7 mm; Dew Pt -16.8.
16:50:02	Good sized snowflakes. Clouds uniformly gray.
16:51:27	Larger particles now fill stick quickly. Max 3.0 mm. Small ones 0.5 mm.
16:53:00	Alt 18,400. Hdg 226. OAT -10. 40.28/76.41. Wind 186/40.
16:54.00	1 to 3 mm flakes. Look like nice snowflakes.
16:54:50	Larger flakes 2 to 3 mm. Alt 18,400. TAS 205 kts.
16:55:25	Big flakes - look like 5-sided stars.
16:58:00	Position: 40.22/76.51. Winds 187/45. Snowstick bimodal; max 2 mm. Most 0.7 mm. A bit brighter.
17:03:48	END PASS 2. 40.17/76.58. Starting descent to 10,000 ft.
17:10:00	At 15,000 ft and descending.
17:11:20	BEGIN PASS 3. Alt. 9,800 ft. in cloud.
17:12:27	Position: 40.39/76.27. Wind 201/44. Particles melt on snowstick.
17:13:42	In clouds-gray again. Light intensity. Large conglomerations of flakes 2 to 3 mm in diameter.
17:16:02	Dew Pt varying from -1 to +1. Flakes still 2 to 3 mm. Intensity still light.
17:17:24	Little light turbulence. In liquid precipitation.
17:22:10	Into snow. Some round (rain) particles.
17:25:00	12 miles south of Wilkes-Barre, PA. Rain now predominant. Less icing than yesterday.
17:26:00	Dew Pt -0.9. Position: 41.14/75.38. Still in wet snow.
17:36:00	END PASS 3.
17:38:00	Still descending.
17:39:00	(Begin to see the bottom of the cloud.)
17:39:30	Level at 5,000 ft.
17:40:07	BEGIN PASS 4. Scattered stratus 400 to 1000 ft above ground.
17:41:40	Ground visible. In rain below the bases of the overcast. Aircraft is 3000 feet above the ground.
17:45:30	Position: 40.51/76.06. Wind 163/41. Altitude 4500 ft. Light rain. Ground not visible. Light turbulence.
17:47:00	Wind 160/40. In continuous rain.
	Breaking into an open area. Ground visible. Clouds at 500 ft and 1000 ft above aircraft. Light turbulence.

Flight Notes From 26 March 1978 - Mission 78-13 (Cont)

<u>TIME</u>	<u>COMMENTS</u>
17:49:27	Ground below is snow covered. We are in rain. Overcast is at 5500 ft.
17:53:48	Position: 40.31/76.31. Wind 157/35. Nothing on snowstick. Rain. Visibility 1/4 mile. Cloud filaments at flight level. Continuous light turbulence.
17:55:12	Cloud tops at flight level—stratified.
17:57:30	Between layers. About one mile visibility. Ground visible through broken Cu below. Moving into heavier rain, obscuring cloud and ground.
18:00:14	Few layered clouds outside.
18:01:50	Light Turbulence.
18:03:45	10 mi from Harrisburg, PA. Visibility 4 mi in light rain. Clouds visible to the side. Clouds appear 1300 ft below.
18:04:24	Going back into cloud. More rain on left side of aircraft.
18:04:57	Visibility decreasing. Dark streak to the right.
18:05:24	Alt 4,700. OAT +7. Pos 40.15/76.55. Wind 166/33.
18:06:30	<u>END PASS 4.</u>
18:08:00	(Climbing-went into cloud deck.)
18:19:00	(Near top of clouds.)
18:23:00	(In Clear between layers.)
18:31:00	(In clear-broken Ci above. Broken Sc below.)
18:49:40	Pos 42.14/80.50. In cloud.
19:15:00	Final comments. Constant clouds and precipitation. Some turbulence.
19:22:45	Land at Wright-Patterson AFB, OH

Appendix B

30-Second Data Averages

Data from the four flights are included in this Appendix. Passes are indicated by brackets, "P" indicating the beginning and "L" at the end of a pass. Those averages used in the samples discussed in Section 7 are indicated with an asterisk (*).

The following information is included:

START TIME	Time the 30-sec average started,
ALT KM	Average pressure altitude in kilometers,
TEMP C	Average temperature in degrees Celsius,
LWC-SC G/m**3	The Liquid Water Content recorded by the Axial Scattering Spectrometer Probe (ASSP) in grams per cubic meter,
LWC-TOT G/m**3	The Liquid Water Content recorded by the cloud and precip probes in grams per cubic meter,
LWC % CLD	Percent of LWC-TOT recorded by the cloud probe,
DO UM	Medium Volume Diameter in microns,
NT N/M**3	The average number of particles per cubic meter observed during the 30-sec period,
L MAX UM	The diameter (in microns) of the largest particle observed during the period by the 1-D system,
FF	The average Form Factor.

AD-A106 417

AIR FORCE GEOPHYSICS LAB HANSCOM AFB MA
DEVELOPMENT OF A LARGE SCALE CLOUD SYSTEM, 23-27 MARCH 1978. (U)

F/6 4/2

MAY 81 I D COMEN

UNCLASSIFIED AFOL-TR-81-0127

NL

2 OF 2
AFOL-TR-81-0127

END
DATE FILMED
12-81
RTIC

NOTE: Start times greater than 23:59:59 indicate a time in the next day (GMT),
(for example, 24:14:32 on 23 March (Flight 78-10) refers to 00:14:32Z on 24 March.

Although Flight 73-10 did extend into a new "day" in "Z" time, it was completed
on 23 March, local time, since there is a 6-hr difference between "Z" time and
Central Standard Time.

23 MAR 70												30 SECOND AVERAGE												30 SECOND AVERAGE												
START	ALT	TEMP	LUC-SC	LUC-TOT	LUC	DO	NT	LMAX	START	ALT	TEMP	LUC-SC	LUC-TOT	LUC	DO	NT	LMAX	START	ALT	TEMP	LUC-SC	LUC-TOT	LUC	DO	NT	LMAX										
TIME	MM	C	G/H*#3	G/H*#3	Z	C/LD	W/H*#3	UN	TIME	MM	C	B/H*#3	B/H*#3	Z	C/LD	W/H*#3	UN	TIME	MM	C	B/H*#3	B/H*#3	Z	C/LD	W/H*#3	UN										
20130.08	7.1	-33.4	.0025	.0000	0	217	1	465	1.00	20159.01	5.7	-21.0	.0000	0	0	0	1.00	2058.31	5.7	-20.9	.0000	0	0	0	0	0	0	0	0	0	0	0	0			
20130.39	7.1	-33.5	.0027	.0000	0	57	288	465	.24	20359.31	5.6	-20.9	.0000	0	0	0	0	2103.01	5.6	-20.9	.0000	0	0	0	0	0	0	0	0	0	0	0	0			
20131.08	7.1	-33.3	.0027	.0000	0	60	200	465	.35	2100.01	5.6	-20.7	.0000	0	0	0	0	2103.31	5.6	-21.3	.0000	0	0	0	0	0	0	0	0	0	0	0	0			
20131.38	7.1	-33.3	.0024	.0000	0	71	64	465	.22	2100.31	5.6	-21.0	.0000	0	0	0	0	2104.01	5.6	-21.5	.0000	0	0	0	0	0	0	0	0	0	0	0	0			
20132.08	7.1	-33.4	.0028	.0000	0	71	74	32	.65	2100.31	5.6	-21.0	.0000	0	0	0	0	2104.01	5.6	-20.7	.0000	0	0	0	0	0	0	0	0	0	0	0	0			
20132.38	7.1	-33.1	.0034	.0000	0	92	40	382	.74	2100.31	5.6	-22.7	.0000	0	0	0	0	2104.01	5.6	-21.2	.0000	0	0	0	0	0	0	0	0	0	0	0	0			
20133.08	7.1	-33.0	.0023	.0000	0	61	89	24	.40	2101.31	5.6	-21.0	.0000	0	0	0	0	2102.01	5.6	-21.2	.0000	0	0	0	0	0	0	0	0	0	0	0	0			
20133.39	7.1	-33.2	.0016	.0000	0	294	0	743	.93	2102.01	5.6	-21.2	.0000	0	0	0	0	2102.31	5.6	-21.0	.0000	0	0	0	0	0	0	0	0	0	0	0	0			
20134.08	7.1	-33.4	.0017	.0000	0	0	30	0	0	2103.01	5.6	-21.2	.0000	0	0	0	0	2103.31	5.6	-21.3	.0007	.1056	12	367	1494.3	5.7	-20.9	.0000	0	0	0					
20134.38	7.1	-34.1	.0034	.0000	0	0	0	0	0	2103.31	5.6	-21.2	.0000	0	0	0	0	2104.01	5.6	-21.5	.0000	.1499	7	502	3572.0	5.7	-20.8	.0000	0	0	0					
20135.08	7.1	-34.7	.0025	.0000	0	0	30	0	0	2104.01	5.6	-21.2	.0000	0	0	0	0	2104.31	5.6	-21.4	.0007	.1518	4	442	3316.9	5.7	-20.8	.0000	0	0	0					
20135.38	7.1	-34.6	.0012	.0000	0	0	30	0	0	2105.01	5.6	-21.4	.0000	0	0	0	0	2105.31	5.6	-21.5	.0000	.1666	0	0	0	0	0	0	0	0	0	0	0	0		
20136.08	7.1	-34.3	.0008	.0000	0	0	30	0	0	2105.31	5.6	-21.4	.0000	0	0	0	0	2106.01	5.6	-20.9	.0000	0	0	0	0	0	0	0	0	0	0	0	0	0		
20136.38	7.1	-33.9	.0020	.0019	14	375	22554	3503	.19	2106.01	5.6	-21.4	.0000	0	0	0	0	2106.31	5.6	-21.5	.0000	.1666	0	0	0	0	0	0	0	0	0	0	0	0	0	
20137.08	7.1	-33.3	.0024	.0000	0	17	359	283732	.16	2106.31	5.6	-20.9	.0000	0	0	0	0	2107.01	5.6	-21.0	.0000	.1666	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20137.38	7.1	-33.0	.0027	.0000	0	13	3754	428	379441	.14	2106.01	5.6	-20.9	.0004	.0071	14	361	2107.01	5.6	-20.8	.0004	.0071	14	361	2272.0	5.7	-20.9	.0000	0	0	0					
20138.08	7.1	-33.7	.0022	.0000	0	12	420	339419	.16	2106.31	5.6	-21.2	.0000	.0248	10	562	2107.01	5.6	-21.2	.0000	.0248	10	562	5360.0	5.7	-20.8	.0000	0	0	0						
20138.38	7.1	-33.7	.0015	.0000	19	333	252621	5228	.16	2107.01	5.6	-21.2	.0000	.0377	11	327	2107.31	5.6	-21.0	.0000	.0377	11	327	18057.0	5.7	-20.8	.0000	0	0	0						
20139.08	7.1	-33.8	.0146	.0000	12	346	147614	5228	.21	2107.31	5.6	-21.0	.0122	.5413	3	646	2108.01	5.6	-21.0	.0122	.5413	3	646	6339.6	5.7	-20.8	.0000	0	0	0						
20139.38	7.1	-33.9	.0011	.0000	23	2348	23	252	183299	.22	2108.01	5.6	-20.9	.0238	.1082	2	804	2108.31	5.6	-21.1	.0238	.1082	2	804	101210.0	5.7	-20.8	.0000	0	0	0					
20140.08	7.1	-34.1	.0016	.0000	39	199	112152	2468	.36	* 2108.31	5.6	-21.1	.0122	.4894	5	531	* 2109.01	5.6	-21.0	.0122	.4894	5	531	7394.0	5.7	-20.8	.0000	0	0	0						
20140.38	7.1	-34.0	.0019	.0000	44	191	181485	2468	.31	* 2109.01	5.6	-20.8	.0133	.5841	3	717	* 2109.31	5.6	-20.8	.0133	.5841	3	717	61287.0	5.7	-20.8	.0000	0	0	0						
20141.08	7.1	-34.2	.0014	.0000	57	172	270127	2664	.33	* 2109.31	5.6	-20.7	.0085	.3539	3	724	* 2109.61	5.6	-20.7	.0085	.3539	3	724	3694.0	5.7	-20.8	.0000	0	0	0						
20141.38	7.1	-34.5	.0024	.0000	47	184	45135	1433	.33	2110.01	5.6	-20.8	.0088	.3663	3	682	2110.31	5.6	-20.8	.0088	.3663	3	682	40652.0	5.7	-20.8	.0000	0	0	0						
20142.08	7.1	-34.4	.0069	.0000	47	185	121914	2468	.36	2110.31	5.6	-20.4	.0133	.7277	3	671	2110.61	5.6	-20.4	.0133	.7277	3	671	72972.0	5.7	-20.8	.0000	0	0	0						
20142.38	7.1	-34.5	.0064	.0000	37	203	113304	2468	.34	2111.01	5.6	-20.4	.0111	.2498	4	1519	2111.31	5.6	-20.4	.0111	.2498	4	1519	14440.0	5.7	-20.8	.0000	0	0	0						
20143.08	7.1	-34.7	.0024	.0000	49	181	38699	2468	.36	2111.31	5.6	-21.2	.0185	.2417	3	671	2112.01	5.6	-21.2	.0185	.2417	3	671	7425.0	5.7	-20.8	.0000	0	0	0						
20143.38	7.1	-34.8	.0028	.0000	34	209	19559	2468	.33	2112.01	5.6	-21.0	.0201	.7530	5	683	2101.01	5.6	-21.0	.0201	.7530	5	683	87015.0	5.7	-20.8	.0000	0	0	0						
20144.08	7.1	-34.2	.0046	.0000	48	183	9528	2468	.33	2112.31	5.6	-21.0	.0201	.7530	5	683	2102.01	5.6	-21.0	.0201	.7530	5	683	135304.0	5.7	-20.8	.0000	0	0	0						
20145.01	7.1	-34.5	.0014	.0000	65	127	28282	1011	.33	2113.01	5.6	-21.3	.0046	.9023	3	763	2113.31	5.6	-21.3	.0046	.9023	3	763	111622.0	5.7	-20.8	.0000	0	0	0						
20145.31	7.1	-34.5	.0002	.0000	47	184	45135	1433	.33	2113.31	5.6	-21.5	.0358	.9581	9	572	2113.61	5.6	-21.5	.0358	.9581	9	572	217530.0	5.7	-20.8	.0000	0	0	0						
20146.01	7.1	-34.3	.0024	.0000	25	194	32214	1622	.26	2114.01	5.6	-21.0	.0038	.13745	0	1621	2114.31	5.6	-21.0	.0038	.13745	0	1621	11595.0	5.7	-20.8	.0000	0	0	0						
20146.31	7.1	-34.3	.0003	.0000	0	0	0	0	0	2114.01	5.6	-21.0	.0000	0	0	0	0	2114.31	5.6	-17.9	.0000	0	0	0	0	0	0	0	0	0	0	0	0	0		
20147.01	7.1	-34.3	.0003	.0000	0	0	0	0	0	2114.31	5.6	-18.1	.0000	0	0	0	0	2114.61	5.6	-17.4	.0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
20147.31	7.1	-33.9	.0004	.0000	0	0	0	0	0	2114.61	5.6	-17.4	.0000	0	0	0	0	2115.01	5.6	-17.4	.0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
20148.01	7.1	-34.0	.0002	.0000	45	151	1082	706	.24	2115.01	5.6	-18.2	.0029	.1343	2	1371	2115.31	5.6	-18.2	.0029	.1343	2	1371	36145.0	5.7	-20.8	.0000	0	0	0						
20148.31	7.1	-34.0	.0003	.0000	0	0	0	0	0	2115.31	5.6	-18.1	.0029	.1343	2	1371	2115.61	5.6	-18.1	.0029	.1343	2	1371	36145.0	5.7	-20.8	.0000	0	0	0						
20149.01	7.1	-34.0	.0003	.0000	0	0	0	0	0	211																										

23 MAR 78												23 MAR 78														
30 SECOND AVERAGE						30 SECOND AVERAGE						30 SECOND AVERAGE						30 SECOND AVERAGE								
START	ALT	TEMP	LUC-SC	LUC-SC	DO	W/H**3	W/H**3	DO	W/H**3	W/H**3	DO	W/H**3	W/H**3	DO	W/H**3	W/H**3	DO	W/H**3	W/H**3	DO	W/H**3	W/H**3	DO	W/H**3		
TIME	km	C	G/H**3	G/H**3	Z	CLD	UN	W/H**3	W/H**3	W/H**3	UN	W/H**3	W/H**3	UN	W/H**3	W/H**3	UN	W/H**3	W/H**3	UN	W/H**3	W/H**3	UN	W/H**3		
21:24:31	3.0	-1.4	.0000	1.379	100	34	1832137	72	1.61	21:54:31	6.1	-23.4	.0008	.0092	.55	174	7014	1778	.53							
21:27:01	3.0	-1.1	.0000	2.147	100	34	2855499	164	1.57	21:55:01	6.1	-24.4	.0008	.0092	.51	251	12418	15631	.35							
21:27:31	3.0	-1.3	.0000	2.393	100	36	34957030	141	1.46	21:55:31	6.2	-24.9	.0008	.0064	.24	332	3234	2813	.36							
21:28:01	3.0	-1.2	.0000	1.897	100	34	25296261	141	1.60	21:56:01	6.3	-25.3	.0008	.0049	.37	207	31122	3848	.34							
21:28:31	3.0	-1.4	.0000	1.178	100	33	14653323	141	1.68	21:56:31	6.5	-26.4	.0003	.0027	.56	169	2372	1433	.45							
21:29:01	3.0	-1.7	.0000	1.0542	100	33	13544108	95	1.65	21:57:01	6.6	-27.2	.0008	.0038	.52	176	3492	2123	.41							
21:29:31	3.0	-1.7	.0000	.9781	100	31	11524446	95	1.77	21:57:31	6.6	-27.1	.0001	.0003	.98	127	535	743	.43							
21:30:01	3.0	-1.8	.0000	.9823	99	34	12710124	647	1.12	21:58:01	6.6	-27.4	.0003	.0022	.96	147	3990	443	.57							
21:30:31	3.0	-1.0	.0004	.0550	83	35	2754472	3849	.02	21:58:31	6.7	-28.1	.0000	.0000	.97	38	465	465	.97							
21:31:01	3.0	-1.0	.0008	1.0248	35	122	4102845	5228	.01	21:59:01	6.8	-28.8	.0000	.0000	1.00	115	46	210	.54							
21:31:31	3.0	-1.0	.0001	.2811	74	36	1974446	5228	.01	21:59:31	6.9	-28.8	.0001	.0010	.40	199	1347	1694	.35							
21:32:01	3.0	-1.7	.0000	.3589	100	28	2445766	72	2.68	22:00:01	7.1	-29.5	.0004	.0004	.13	292	2228	1778	.34							
21:32:31	3.0	-1.4	.0000	.2941	100	28	2156270	72	2.65	22:00:31	7.1	-29.5	.0026	.0039	.25	232	15313	2464	.38							
21:33:01	3.0	-1.4	.0000	.0029	100	25	9057	43	5.29	22:01:01	7.1	-30.0	.0018	.0015	.37	201	13542	2448	.41							
21:33:31	3.0	-1.4	.0000	0.0000	0	0	0	2	0.00	22:01:31	7.1	-30.4	.0051	.0079	.9	300	25453	2468	.36							
21:34:01	3.0	-1.9	.0000	0.0000	0	0	0	10	0.00	22:02:01	7.1	-30.3	.0033	.0027	.12	302	26420	2468	.36							
21:34:31	3.0	-1.7	.0000	0.0000	0	0	0	4	0.00	22:02:31	7.1	-30.4	.0001	.0001	.00	302	26420	2468	.37							
21:35:01	3.0	-1.7	.0001	.0991	0	0	0	2555	181	5228	.26	22:03:01	7.2	-30.4	.0002	.0084	.4	342	19710	2813	.37					
21:35:31	3.0	-1.2	.0002	.2330	0	2221	193	5228	.43	22:03:31	7.2	-30.2	.0005	.0053	.1844	4	365	34182	5228	.34						
21:36:01	3.0	-1.5	.0011	.7810	1	2158	4884	5228	.16	22:04:01	7.2	-30.1	.0012	.0026	.15	293	79187	5228	.26							
21:36:31	3.0	-1.4	.0000	.0135	2011	7	4883	.52	22:04:31	7.2	-30.3	.0079	.0066	.26	229	71676	2468	.35								
21:37:01	3.0	-1.3	.0000	.0013	0	1963	1	2813	.75	22:05:01	7.2	-30.4	.0097	.0073	.15	229	43371	3159	.34							
21:37:31	3.0	-1.3	.0000	0.0000	0	0	0	0	0	22:05:31	7.2	-30.4	.0011	.0027	.12	328	57663	3448	.29							
21:38:01	3.0	-1.4	.0000	0.0000	0	0	0	0	0	22:06:01	7.2	-30.4	.0083	.0075	.24	244	5437	5228	.27							
21:38:31	3.0	-1.2	.0000	.0136	0	1937	9	4193	.58	22:06:31	7.2	-30.1	.0057	.0011	.27	219	28657	2468	.41							
21:39:01	3.0	-1.4	.0000	1.0350	0	2228	3982	.20	22:07:01	7.1	-29.5	.0151	.015	.15	280	52913	4893	.32								
21:39:31	3.0	-1.4	.0024	1.0350	0	1710	6964	5228	.21	22:07:31	7.1	-29.4	.0153	.0153	.2352	13	323	72702	5228	.29						
* 21:40:01	3.0	-1.3	.0024	.8445	2	1705	8761	5228	.17	22:08:01	7.1	-29.3	.0093	.0079	.15	328	33467	3848	.36							
* 21:40:31	3.0	-1.5	.0036	1.4743	1	1726	11175	5228	.19	22:08:31	7.1	-29.5	.0141	.0153	.21	243	79378	3159	.34							
* 21:41:01	3.0	-1.0	.0003	.1338	0	1628	341	5228	.32	22:09:01	7.1	-29.7	.0101	.0113	.18	272	48810	3159	.31							
* 21:41:31	3.1	-1.4	.0001	.1937	0	1660	906	4193	.9	22:09:31	7.1	-29.8	.0131	.0131	.16	297	51127	4881	.28							
21:42:01	3.0	-1.7	.0006	.1874	1	2105	5228	.12	22:10:01	7.1	-29.6	.0036	.0036	.24	244	12866	2813	.27								
21:42:31	3.1	-2.6	.0000	.0435	0	1857	870	4193	.11	22:10:31	7.1	-29.4	.0039	.0039	.13	213	12662	2468	.27							
21:43:01	3.2	-3.4	.0006	.0247	4	739	2528	.19	22:11:01	7.1	-29.1	.0014	.0014	.10	76	31	118	1:00								
21:43:31	3.4	-4.5	.0019	.0306	4	894	3337	5228	.16	22:11:31	7.1	-29.0	.0010	.0000	0	0	0	30	0.00							
21:44:01	3.6	-6.0	.0014	.0005	7	295	325	1088	.33	22:12:01	7.1	-28.9	.0004	.0000	.00	0	23	0.00								
21:44:31	3.7	-6.6	.0021	.0006	59	171	339	1088	.45	22:12:31	7.1	-28.9	.0003	.0003	.00	0	23	0.00								
21:45:01	3.9	-7.8	.0007	.0016	44	196	645	1088	.58	22:13:01	7.1	-28.9	.0026	.0019	.16	259	870	2468	.42							
21:45:31	4.0	-8.8	.0047	.0006	49	181	563	1433	.39	22:13:31	7.1	-28.7	.0139	.0139	.16	245	86180	4193	.34							
21:46:01	4.1	-9.7	.0017	.0047	26	228	535	1433	.42	22:14:01	7.1	-28.0	.0150	.0150	.1789	18	280	81869	5228	.30						
21:46:31	4.2	-10.5	.0089	.0088	13	297	2011	1778	.48	22:14:31	7.1	-28.0	.0153	.0153	.1281	11	310	44635	5228	.33						
21:47:01	4.4	-11.4	.0009	.0095	8	345	1592	6468	.43	22:15:01	7.1	-28.7	.0110	.0110	.1114	11	327	36567	5228	.24						
21:47:31	4.5	-12.5	.0027	.0047	20	244	1460	1433	.49	22:15:31	7.1	-28.7	.0038	.0034	.0344	47	184	36430	2468	.47						
21:48:01	4.6	-13.4	.0145	.0324	5	412	5502	5228	.31	22:16:01	7.1	-28.4	.0037	.0033	.50	179	27812	2468	.50							
21:48:31	4.7	-14.4	.0070	.0224	7	352	2813	.44	22:16:31	7.1	-28.4	.0026	.0026	.0000	0	0	0	0								
21:49:01	4.9	-15.0	.0015	.0025	14	344	1428	2123	.25	22:17:01	7.1	-28.5	.0021	.0021	.0000	0	0	0	0							
21:49:31	5.0	-15.4	.0000	.0000	0	0	0	0	2	22:17:31	7.1	-28.5	.0095	.0095	.0000	0	0	0	0							
21:50:01	5.1	-16.0	.0000	.0000	0	0	0	0	0	22:18:01	7.1	-28.5	.0001	.0015	.0000	0	0	0	0							
21:50:31	5.2	-16.1	.0000	.0000	0	0	0	0	0	22:18:31	7.1	-28.4	.0010	.0000	0	0	0	0								
21:51:01	5.3	-16.8	.0000	.0000	100	51	326	22	.00	22:19:01	7.1	-28.4	.0010	.0000	0	0	0	0								
21:51:31	5.4	-17.8	.0000	.0000	19																					

ALI	23 MAR 78			30 SECOND			AVERAGE		
	TEMP	LUC-SC	LUC-T	LUC-0.1	LUC-2	LUC	UN	UN	UN
INSTANT	TIME	MM	HH:MM:SS	MM:SS	MM:SS	MM:SS	MM:SS	MM:SS	MM:SS
22/22/2101	7.1	-28.3	.0057	-16.15	4	351	28074	22315	220537
22/22/2101	7.1	-28.3	.0047	-11.37	4	136	22315	25307	21015
22/22/2101	7.1	-28.3	.0047	-0.93	5	324	22315	2945	1694
22/22/2101	7.1	-28.1	.0073	-18.51	5	353	36789	36789	36789
22/22/2101	7.1	-28.1	.0055	-11.79	4	523	79510	79510	79510
22/22/2101	7.1	-27.4	.0203	-78.84	5	510	137398	97421	94945
22/22/2101	7.1	-27.4	.0162	-73.13	3	587	97421	12193	12193
22/22/2101	7.1	-27.2	.0178	-78.21	3	570	99450	12193	12193
22/22/2101	7.1	-27.6	.0035	-0.06	22	244	21015	2945	1694
22/22/2101	7.1	-27.6	.0035	-0.10	3	774	2945	2945	2945
22/22/2101	7.1	-26.9	.0002	-0.02	4	628	139	0	0
22/22/2101	7.1	-26.8	.0000	0	0	0	0	0	0
22/22/2101	7.1	-24.9	.0001	-0.03	6	596	399	399	399
22/22/2101	7.1	-24.9	.0001	-0.04	6	523	79510	79510	79510
22/22/2101	7.1	-27.5	.0106	-40.41	6	512	104410	104410	104410
22/22/2101	7.1	-27.5	.0155	-40.28	4	484	104410	104410	104410
22/22/2101	7.1	-27.5	.0165	-6.36	4	484	104410	104410	104410
22/22/2101	7.1	-27.4	.0198	-74.70	5	472	132193	132193	132193
22/22/2101	7.1	-27.3	.0201	-6.32	6	421	123040	123040	123040
22/22/2101	7.1	-27.3	.0147	-4.94	5	413	91113	91113	91113
22/23/3101	7.1	-22.5	.0147	-3.91	6	437	76217	76217	76217
22/23/3101	7.1	-22.7	.0113	-3.91	6	451	79029	79029	79029
22/23/3101	7.1	-22.5	.0106	-3.60	4	508	449855	449855	449855
22/23/3101	7.1	-22.6	.0089	-3.27	10	508	449855	449855	449855
22/23/3101	7.1	-22.6	.0084	-2.53	6	335	449855	449855	449855
22/23/3101	7.1	-22.6	.0078	-1.58	8	321	432994	432994	432994
22/23/3101	7.1	-22.7	.0099	-1.58	4	402	617755	617755	617755
22/23/3101	7.1	-22.7	.0054	-7.59	3	445	108984	108984	108984
22/23/3101	7.1	-22.7	.0181	-8.04	3	443	108676	108676	108676
22/23/3101	7.1	-22.7	.0123	-4.81	5	392	76876	76876	76876
22/23/3101	7.1	-22.7	.0101	-2.74	5	384	607355	607355	607355
22/23/3101	7.1	-28.4	.0101	-2.70	6	355	712460	712460	712460
22/23/3101	7.1	-29.0	.0083	-1.85	6	335	520203	520203	520203
22/23/3101	7.1	-28.9	.0071	-1.53	6	312	361729	361729	361729
22/23/3101	7.1	-28.9	.0076	-1.58	8	321	342994	342994	342994
22/23/3101	7.1	-28.8	.0078	-1.42	20	5340	340510	340510	340510
22/23/3101	7.1	-28.8	.0061	-1.19	16	274	45627	45627	45627
22/23/3101	7.1	-28.7	.0070	-1.04	6	324	365542	365542	365542
22/23/3101	7.1	-29.2	.0044	-0.89	7	304	246468	246468	246468
22/23/3101	7.1	-29.2	.0047	-0.84	5	316	225755	225755	225755
22/23/3101	7.1	-29.2	.0061	-0.65	5	314	169151	169151	169151
22/23/3101	7.1	-29.5	.0064	-1.42	5	338	370973	370973	370973
22/23/3101	7.1	-29.1	.0061	-1.25	7	328	337710	337710	337710
22/23/3101	7.1	-29.1	.0070	-1.19	7	321	372150	372150	372150
22/23/3101	7.1	-29.0	.0058	-1.03	4	328	225355	225355	225355
22/23/3101	7.1	-29.0	.0044	-0.89	4	303	209415	209415	209415
22/23/3101	7.1	-29.5	.0044	-0.64	4	328	209252	209252	209252
22/23/3101	7.1	-29.5	.0045	-0.65	4	310	184110	184110	184110
22/23/3101	7.1	-29.4	.0042	-0.67	4	317	246455	246455	246455
22/23/3101	7.1	-29.5	.0044	-0.93	4	318	225755	225755	225755
22/23/3101	7.1	-29.5	.0047	-0.93	4	318	287468	287468	287468
22/23/3101	7.1	-29.4	.0045	-0.64	4	317	273824	273824	273824
22/23/3101	7.1	-29.4	.0043	-0.76	4	317	287468	287468	287468

23 MAR 78												30 SECOND AVERAGE												30 MIN/78													
START	TEMP	LWC-SC	LWC-TOT	LWC	UN	WT	LMAX	FF	ALT	TEMP	LWC-SC	LWC-TOT	LWC	UN	WT	LMAX	FF	ALT	TEMP	LWC-SC	LWC-TOT	LWC	UN	WT	LMAX	FF											
23119101	5.4	-17.0	.0081	.1352	7	511	20684	4883	.19	2314431	3.0	.0	.0041	2.1035	2	2041	5292	.16	2314431	3.0	.0	.0041	4.1888	2	2084	5228	.16										
23119101	5.4	-16.8	.0092	.1477	7	541	20678	4883	.19	2314431	3.0	.0	.0041	4.1882	2	2074	40787	.14	2314431	3.0	.0	.0041	4.5342	2	2074	5228	.14										
23119101	5.4	-16.8	.0096	.1461	8	544	23132	5228	.18	2314431	3.0	.0	.0041	4.1887	2	2079	35724	.15	2314431	3.0	.0	.0041	4.5342	2	2079	5228	.15										
23119101	5.4	-16.8	.0059	.1518	10	485	25135	5228	.20	2314431	3.0	.0	.0041	4.1887	2	2074	40787	.14	2314431	3.0	.0	.0041	4.5342	2	2074	5228	.14										
23120101	5.4	-16.8	.0072	.2013	13	417	44044	5228	.19	2314431	3.0	.0	.0031	3.3372	2	2084	26575	.15	23120101	5.4	-16.8	.0072	.2013	13	417	44044	5228	.19	2314431	3.0	.0	.0031	3.3372	2	2084	26575	.15
23120101	5.4	-16.1	.0088	.2266	10	494	47217	5228	.19	23149102	3.0	.0	.0023	2.2402	3	2157	19394	.14	23120101	5.4	-16.1	.0088	.2266	10	494	47217	5228	.19	23149102	3.0	.0	.0023	2.2402	3	2157	19394	.14
23121101	5.4	-15.6	.0100	.3416	7	543	49837	5228	.18	23149102	3.0	.0	.0018	1.5086	3	2134	19025	.12	23121101	5.4	-15.6	.0100	.3416	7	543	49837	5228	.18	23149102	3.0	.0	.0018	1.5086	3	2134	19025	.12
23122101	5.3	-15.2	.0124	.3443	4	459	53477	5228	.22	23150102	3.0	.0	.0022	1.4528	3	2073	15227	.13	23122101	5.3	-15.2	.0124	.3443	4	459	53477	5228	.22	23150102	3.0	.0	.0022	1.4528	3	2073	15227	.13
23122101	5.3	-14.4	.0124	.3443	4	459	53477	5228	.22	23150102	3.0	.0	.0022	1.4528	3	2073	15227	.13	23122101	5.3	-14.4	.0124	.3443	4	459	53477	5228	.22	23150102	3.0	.0	.0022	1.4528	3	2073	15227	.13
23122101	5.3	-14.3	.0112	.2378	6	528	31657	5228	.19	23151102	3.0	.0	.0029	1.9988	4	1701	24585	.14	23122101	5.3	-14.3	.0112	.2378	6	528	31657	5228	.19	23151102	3.0	.0	.0029	1.9988	4	1701	24585	.14
23123101	5.3	-14.3	.0024	.2224	5	562	25580	5228	.19	23151102	3.0	.0	.0022	1.5026	2	1878	13862	.16	23123101	5.3	-14.3	.0024	.2224	5	562	25580	5228	.19	23151102	3.0	.0	.0022	1.5026	2	1878	13862	.16
23124101	5.3	-14.2	.0088	.2359	4	538	26416	5228	.21	23152102	3.0	.0	.0039	3.4724	2	1982	29182	.14	23124101	5.3	-14.2	.0088	.2359	4	538	26416	5228	.21	23152102	3.0	.0	.0039	3.4724	2	1982	29182	.14
23124101	5.3	-14.3	.0103	.3402	4	499	40416	5228	.24	23152102	3.0	.0	.0048	5.2580	2	1988	34327	.14	23124101	5.3	-14.3	.0103	.3402	4	499	40416	5228	.24	23152102	3.0	.0	.0048	5.2580	2	1988	34327	.14
23125101	5.3	-14.3	.0117	.4327	4	512	52884	5228	.21	23153102	3.0	.0	.0045	4.6111	2	1897	34810	.14	23125101	5.3	-14.3	.0117	.4327	4	512	52884	5228	.21	23153102	3.0	.0	.0045	4.6111	2	1897	34810	.14
23125101	5.3	-14.4	.0145	.3443	3	515	57825	5228	.22	23153102	3.0	.0	.0036	1.0317	3	1875	29465	.15	23125101	5.3	-14.4	.0145	.3443	3	515	57825	5228	.22	23153102	3.0	.0	.0036	1.0317	3	1875	29465	.15
23125101	5.3	-14.4	.0145	.3443	3	515	57825	5228	.22	23153102	3.0	.0	.0036	1.0317	3	1875	29465	.15	23125101	5.3	-14.4	.0145	.3443	3	515	57825	5228	.22	23153102	3.0	.0	.0036	1.0317	3	1875	29465	.15
23126101	5.3	-14.5	.0125	.5206	3	515	48412	5228	.25	23154102	3.0	.0	.0027	2.8024	2	1818	23342	.17	23126101	5.3	-14.5	.0125	.5206	3	515	48412	5228	.25	23154102	3.0	.0	.0027	2.8024	2	1818	23342	.17
23126101	5.3	-14.3	.0187	.9668	2	588	70613	5228	.24	23155102	3.0	.0	.0031	2.6359	3	1887	29982	.16	23126101	5.3	-14.3	.0187	.9668	2	588	70613	5228	.24	23155102	3.0	.0	.0031	2.6359	3	1887	29982	.16
23127101	5.2	-14.0	.0218	1.3521	2	611	99243	5228	.22	23155102	3.0	.0	.0034	2.3895	2	1898	18892	.14	23127101	5.2	-14.0	.0218	1.3521	2	611	99243	5228	.22	23155102	3.0	.0	.0034	2.3895	2	1898	18892	.14
23128101	5.2	-14.0	.0240	2.1497	2	692	120230	5228	.22	23155102	3.0	.0	.0037	2.1103	3	1773	24633	.14	23128101	5.2	-14.0	.0240	2.1497	2	692	120230	5228	.22	23155102	3.0	.0	.0037	2.1103	3	1773	24633	.14
23128101	5.2	-13.9	.0240	1.8951	2	691	110159	5228	.22	23156102	3.0	.0	.004	1.5263	3	1725	12553	.14	23128101	5.2	-13.9	.0240	1.8951	2	691	110159	5228	.22	23156102	3.0	.0	.004	1.5263	3	1725	12553	.14
23129101	5.2	-13.9	.0184	1.4509	2	497	86492	5228	.22	23157102	3.0	.0	.0037	2.3091	2	2044	21059	.15	23129101	5.2	-13.9	.0184	1.4509	2	497	86492	5228	.22	23157102	3.0	.0	.0037	2.3091	2	2044	21059	.15
23129101	5.2	-13.5	.0156	.7040	4	517	81734	5228	.22	23158102	3.0	.0	.0031	3.3150	2	2274	23341	.09	23129101	5.2	-13.5	.0156	.7040	4	517	81734	5228	.22	23158102	3.0	.0	.0031	3.3150	2	2274	23341	.09
23130101	5.2	-13.1	.0190	.6062	3	649	90497	5228	.20	23158102	3.0	.0	.0036	4.6354	2	23174	30240	.08	23130101	5.2	-13.1	.0190	.6062	3	649	90497	5228	.20	23158102	3.0	.0	.0036	4.6354	2	23174	30240	.08
23130101	5.2	-13.1	.0226	1.4301	3	661	12257	5228	.19	23159102	3.0	.0	.0042	4.8450	2	1866	61969	.10	23130101	5.2	-13.1	.0226	1.4301	3	661	12257	5228	.19	23159102	3.0	.0	.0042	4.8450	2	1866	61969	.10
2313101	5.2	-13.2	.0223	2.4517	2	813	132356	5228	.20	23159102	3.0	.0	.0041	5.4514	2	1971	61750	.11	2313101	5.2	-13.2	.0223	2.4517	2	813	132356	5228	.20	23159102	3.0	.0	.0041	5.4514	2	1971	61750	.11
2313101	5.2	-13.4	.0235	2.4467	1	834	129357	5228	.20	24100102	3.0	.0	.0068	6.1304	2	1961	61436	.12	2313101	5.2	-13.4	.0235	2.4467	1	834	129357	5228	.20	24100102	3.0	.0	.0068	6.1304	2	1961	61436	.12
23132101	5.0	-12.2	.0228	2.3617	2	871	115152	5228	.18	23153102	3.0	.0	.0037	3.7272	2	1964	23470	.15	23132101	5.0	-12.2	.0228	2.3617	2	871	115152	5228	.18	23153102	3.0	.0	.0037	3.7272	2	1964	23470	.15
23133101	4.9	-11.8	.0236	22.1390	1	1792	113213	5228	.21	2410102	3.0	.0	.0022	2.1277	2	1874	12706	.19	23133101	4.9	-11.8	.0236	22.1390	1	1792	113213	5228	.21	2410102	3.0	.0	.0022	2.1277	2	1874	12706	.19
23133101	4.9	-11.4	.0282	24.1715	1	1930	131407	5228	.19	2410102	3.0	.0	.0049	3.7598	2	2122	33149	.14	23133101	4.9	-11.4	.0282	24.1715	1	1930	131407	5228	.19	2410102	3.0	.0	.0049	3.7598	2	2122	33149	.14
23134101	4.8	-10.9	.0295	12.2708	1	1946	121748	5228	.19	2410202	3.0	.0	.0075	4.4882	3	2170	47146	.13	23134101	4.8	-10.9	.0295	12.2708	1	1946	121748	5228	.19	2410202	3.0	.0	.0075	4.4882	3	2170	47146	.13
23135101	4.7	-10.1	.0230	23.4359	1	1950	132527	5228	.19	2410302	3.0	.0	.0052	3.8269	3	2242																					

START TIME	ALT MM	TEMP C	30 SECOND AVERAGE			LMAX MM	NT MM	FF
			LUC-SC 6/19+3	LUC-101 LUC 6/19+3 x CLO	BO UN			
24101922	2.4	2.5	.0004	.1587	5	1748	3194	.12
24101922	2.4	2.5	.0004	.0940	2	1578	2977	.09
24101922	2.2	5.2	.0002	.0824	1	1524	942	.16
24101922	2.2	5.2	.0002	.0767	4	1584	1267	.14
24101922	2.1	6.3	.0002	.0668	0	1365	366	.15
24101922	2.0	7.2	.0002	.1168	0	1195	4508	.15
24101922	1.8	8.2	.0004	.1773	0	693	3014	.19
24101922	1.7	9.2	.0005	.4098	-	1429	5548	.18
24101922	1.7	10.2	.0005	.4998	-	1270	5220	.11
24101922	1.5	10.2	.0004	.3250	1	1316	3746	.19
24101922	1.5	9.4	.0005	.3911	2	1273	7737	.11
24101922	1.5	9.1	.0005	.2810	2	1469	5372	.09
24101922	1.5	9.2	.0003	.2724	2	1380	3610	.14
24101922	1.5	9.4	.0003	.1618	3	1212	2462	.23
* 24101922	1.5	9.7	.0002	.1151	4	1268	2451	.13
* 24101922	1.5	10.0	.0001	.1184	4	1515	2827	.09
24102002	1.5	10.2	.0001	.0864	2	1332	1046	.19
24102002	1.5	10.1	.0001	.0667	2	1243	1239	.19
24102002	1.5	9.8	.0001	.1022	1	1191	549	.21
24102002	1.5	9.8	.0002	.1092	1	1199	1101	.24
24102002	1.5	9.4	.0002	.1708	1	1420	1628	.21
24102002	1.5	9.4	.0002	.1723	2	1337	1892	.18
24102002	1.5	9.5	.0002	.1353	3	1589	1240	.23
24102002	1.5	9.2	.0002	.1489	0	1437	977	.22
24102002	1.5	9.1	.0002	.1092	2	1282	1188	.17
24102002	1.5	9.0	.0002	.1087	1	1408	747	.22
24102002	1.5	8.9	.0003	.1594	0	1680	1693	.15
24102002	1.5	8.8	.0002	.1212	1	1772	1369	.15
24102002	1.5	8.7	.0004	.1388	2	1220	2416	.14
24102002	1.5	9.0	.0003	.1070	3	1034	1523	.25
24102002	1.5	8.7	.0017	.2158	2	1202	2640	.16
24102002	1.5	8.7	.0032	.4554	2	1810	8790	.07
24102002	1.5	8.3	.0026	.2994	3	1582	5094	.12
24102002	1.5	8.3	.0005	.3547	1	1979	3272	.12
24102002	1.5	8.2	.0005	.3504	2	2010	4766	.11
24102002	1.5	8.4	.0042	.8185	4	1974	13781	.09
24102002	1.5	8.0	.0011	.4880	2	2090	5974	.10
24102002	1.5	8.2	.0044	.4387	1	2657	6885	.21
24102002	1.5	8.1	.0081	.5169	2	1639	7349	.15
24102002	1.5	7.9	.0052	.2242	1	1487	2772	.13
24102002	1.5	8.2	.0075	.1797	2	1671	3971	.07
* 24102002	1.5	8.3	.0010	.1494	1	1784	1196	.14
* 24102002	1.5	8.7	.0025	.5333	0	2055	2233	.10
* 24102002	1.5	8.8	.0011	.4111	2	1770	16798	.06
* 24102002	1.5	8.8	.0004	.3678	2	1980	3914	.14
* 24102002	1.5	8.7	.0006	.4271	2	1785	4384	.10
* 24102002	1.5	8.8	.0094	.4459	1	1795	5643	.13
* 24102002	1.5	9.0	.0008	.4274	1	1938	5449	.13
* 24102002	1.5	9.0	.0003	.4219	1	1815	4677	.12
* 24102002	1.5	9.1	.0031	.4111	2	1770	3914	.06
* 24102002	1.5	8.7	.0011	.4124	1	2112	7535	.12
* 24102002	1.5	8.8	.0004	.3678	2	2001	5291	.11
* 24102002	1.5	8.9	.0003	.4274	2	2174	7245	.08
* 24102002	1.5	9.0	.0005	.4143	1	2199	8369	.12
* 24102002	1.5	9.0	.0005	.3249	2	1997	6243	.19
* 24102002	1.5	8.8	.0004	.4444	2	2059	3417	.07
* 24102002	1.5	8.8	.0004	.3021	3	1827	3623	.12

START TIME	24 MAR 78			30 SECOND AVERAGE			30 SEC			AVERAGE		
	TEMP C	LUC-SC 8/Heo3	LUC-TOT LUC 8/Heo3 2 CLD	DM UN	W/Heo3 UN	W/Heo3 UN	NT	LMAX UN	MT UN	W/Heo3 UN	LTMAX UN	FF
19:30:12 7.1 -30.7	.0024 .0374	.0024 .0374	.0024 .0374	33 41	1821 195	2026 1921	2468 2464	.53 .57	19:58:02 19:58:32	.52 .52	.0273 .0273	17 17
19:30:32 7.1 -30.7	.0024 .0374	.0024 .0374	.0024 .0374	41 52	195	1921 2359	2468 2468	.53 .53	19:59:02 19:59:32	.52 .52	.0272 .0272	.0314 .0314
19:31:02 7.1 -30.8	.0024 .0374	.0024 .0374	.0024 .0374	55 55	173	19250 1431	1431 1433	.55 .40	19:59:32 20:00:02	.52 .52	.0275 .0272	.0317 .0317
19:31:32 7.1 -30.8	.0024 .0374	.0024 .0374	.0024 .0374	40 40	1649	24048 1433	2468 1433	.40 .40	20:00:02 20:00:32	.52 .52	.0274 .0274	.0315 .0315
19:32:02 7.1 -30.7	.0027 .0379	.0027 .0379	.0027 .0379	54 54	20464 12247	2468 2468	2468 2468	.54 .54	* 20:00:32 * 20:01:32	.52 .52	.0279 .0279	.0310 .0310
19:32:32 7.1 -30.9	.0024 .0374	.0024 .0374	.0024 .0374	175 175	20297 12123	2468 2468	2468 2468	.53 .53	* 20:01:02 * 20:01:02	.52 .52	.0274 .0274	.0310 .0310
19:33:02 7.1 -31.2	.0025 .0375	.0025 .0375	.0025 .0375	30 19	2337 15463	2468 2468	2468 2468	.52 .54	* 20:01:32 28:02:02	.52 .52	.0275 .0275	.0310 .0309
19:34:02 7.1 -31.2	.0024 .0374	.0024 .0374	.0024 .0374	41 18	2336 1410	2468 2468	2468 2468	.54 .54	20:02:32 20:03:02	.52 .52	.0277 .0275	.0314 .0313
19:34:32 7.1 -31.0	.0029 .0379	.0029 .0379	.0029 .0379	18 18	0504 16132	2468 2468	2468 2468	.54 .54	20:03:02 20:03:32	.52 .52	.0273 .0273	.0317 .0317
19:35:02 7.1 -31.0	.0021 .0356	.0021 .0356	.0021 .0356	12 12	2464 10792	2468 2468	2468 2468	.48 .48	20:03:32 20:04:02	.52 .52	.0274 .0274	.0314 .0314
19:35:32 7.1 -31.1	.0031 .0371	.0031 .0371	.0031 .0371	13 13	2535 12218	2468 2468	2468 2468	.53 .53	20:04:02 20:04:32	.52 .52	.0278 .0278	.0314 .0314
19:36:02 7.1 -31.0	.0028 .0378	.0028 .0378	.0028 .0378	10 274	12445 9134	2468 2468	2468 2468	.50 .47	20:04:32 20:05:02	.52 .52	.0276 .0276	.0314 .0314
19:36:32 7.1 -31.1	.0028 .0378	.0028 .0378	.0028 .0378	8 10	2087 2724	2468 2468	2468 2468	.50 .50	20:05:02 20:05:32	.52 .52	.0275 .0275	.0314 .0314
19:37:02 7.1 -31.1	.0028 .0378	.0028 .0378	.0028 .0378	10 10	0528 2912	2468 2468	2468 2468	.50 .50	20:05:32 20:06:02	.52 .52	.0275 .0275	.0314 .0314
19:37:32 7.1 -31.1	.0029 .0379	.0029 .0379	.0029 .0379	7 7	0237 2912	2468 2468	2468 2468	.51 .51	20:06:02 20:06:32	.52 .52	.0275 .0275	.0314 .0314
19:38:02 7.1 -31.0	.0031 .0371	.0031 .0371	.0031 .0371	7 7	0237 2912	2468 2468	2468 2468	.51 .51	20:06:32 20:07:02	.52 .52	.0275 .0275	.0314 .0314
19:38:32 7.1 -31.0	.0031 .0371	.0031 .0371	.0031 .0371	3 3	0225 3192	2468 2468	2468 2468	.51 .51	20:07:02 20:07:32	.52 .52	.0275 .0275	.0314 .0314
19:39:02 7.1 -30.9	.0033 .0373	.0033 .0373	.0033 .0373	4 4	0221 321	2468 2468	2468 2468	.49 .49	20:07:32 20:08:02	.52 .52	.0274 .0274	.0314 .0314
19:39:32 7.1 -30.8	.0035 .0375	.0035 .0375	.0035 .0375	3 3	0221 321	2468 2468	2468 2468	.49 .49	20:08:02 20:08:32	.52 .52	.0274 .0274	.0314 .0314
19:40:02 7.1 -30.4	.0032 .0372	.0032 .0372	.0032 .0372	4 4	0111 315	2468 13270	2468 2468	.45 .45	20:08:32 20:09:02	.52 .52	.0276 .0276	.0314 .0314
19:40:32 7.1 -29.9	.0049 .0416	.0049 .0416	.0049 .0416	7 7	0136 302	2468 2468	2468 2468	.51 .51	20:09:02 20:09:32	.52 .52	.0276 .0276	.0314 .0314
19:41:02 7.1 -29.4	.0046 .0413	.0046 .0413	.0046 .0413	4 4	0136 312	2468 2468	2468 2468	.48 .48	20:09:32 20:10:02	.52 .52	.0276 .0276	.0314 .0314
19:41:32 7.1 -29.5	.0033 .0373	.0033 .0373	.0033 .0373	7 7	0135 305	2468 15793	2468 2813	.47 .47	20:10:02 20:10:32	.52 .52	.0275 .0275	.0314 .0314
19:42:02 7.1 -30.2	.0036 .0376	.0036 .0376	.0036 .0376	5 5	0136 316	2468 4883	2468 2813	.43 .43	20:10:32 20:11:02	.52 .52	.0276 .0276	.0314 .0314
19:42:32 7.1 -30.4	.0031 .0371	.0031 .0371	.0031 .0371	5 5	0135 321	2468 12260	2468 2468	.47 .47	20:11:02 20:11:32	.52 .52	.0276 .0276	.0314 .0314
19:43:02 7.1 -30.4	.0028 .0372	.0028 .0372	.0028 .0372	4 4	0111 315	2468 13270	2468 2468	.45 .45	20:11:32 20:12:02	.52 .52	.0276 .0276	.0314 .0314
19:43:32 7.1 -30.7	.0027 .0371	.0027 .0371	.0027 .0371	4 4	0111 302	2468 13270	2468 2468	.45 .45	20:12:02 20:12:32	.52 .52	.0276 .0276	.0314 .0314
19:44:02 7.1 -31.2	.0029 .0379	.0029 .0379	.0029 .0379	8 8	0136 2912	2468 13270	2468 2468	.46 .46	20:12:32 20:13:02	.52 .52	.0276 .0276	.0314 .0314
19:44:32 7.1 -31.2	.0020 .0372	.0020 .0372	.0020 .0372	9 9	0144 195	2468 1433	2468 1433	.44 .44	20:13:02 20:13:32	.52 .52	.0276 .0276	.0314 .0314
19:45:02 7.1 -31.4	.0016 .0374	.0016 .0374	.0016 .0374	43 43	0143 191	2468 1433	2468 1433	.43 .43	20:13:32 20:14:02	.52 .52	.0276 .0276	.0314 .0314
19:45:32 7.1 -31.5	.0023 .0375	.0023 .0375	.0023 .0375	57 57	0143 174	2468 21749	2468 1098	.56 .56	20:14:02 20:14:32	.52 .52	.0276 .0276	.0314 .0314
19:46:02 7.1 -31.7	.0027 .0379	.0027 .0379	.0027 .0379	58 58	0147 174	2468 23920	2468 2468	.47 .47	20:14:32 20:15:02	.52 .52	.0276 .0276	.0314 .0314
19:46:32 7.1 -30.8	.0026 .0378	.0026 .0378	.0026 .0378	55 42	0116 193	2468 19430	2468 2468	.45 .45	20:15:02 20:15:32	.52 .52	.0276 .0276	.0314 .0314
19:47:02 7.1 -30.7	.0025 .0377	.0025 .0377	.0025 .0377	37 37	0147 199	2468 14895	2468 2468	.56 .56	20:15:32 20:16:02	.52 .52	.0276 .0276	.0314 .0314
19:47:32 7.1 -30.1	.0030 .0379	.0030 .0379	.0030 .0379	40 40	0144 195	2468 14430	2468 2468	.46 .46	20:16:02 20:16:32	.52 .52	.0276 .0276	.0314 .0314
19:48:02 7.1 -31.4	.0026 .0372	.0026 .0372	.0026 .0372	34 34	0143 175	2468 22826	2468 1098	.69 .69	20:16:32 20:17:02	.52 .52	.0276 .0276	.0314 .0314
19:48:32 7.1 -30.2	.0023 .0375	.0023 .0375	.0023 .0375	54 54	0145 1433	2468 31315	2468 1433	.44 .44	20:17:02 20:17:32	.52 .52	.0276 .0276	.0314 .0314
19:49:02 7.1 -30.9	.0026 .0378	.0026 .0378	.0026 .0378	61 61	0147 174	2468 27492	2468 1098	.51 .51	20:17:32 20:18:02	.52 .52	.0276 .0276	.0314 .0314
19:49:32 7.1 -31.9	.0019 .0374	.0019 .0374	.0019 .0374	62 62	0119 174	2468 1908	2468 1908	.59 .59	20:18:02 20:18:32	.52 .52	.0276 .0276	.0314 .0314
19:50:02 7.1 -31.4	.0015 .0374	.0015 .0374	.0015 .0374	83 83	0148 1433	2468 17550	2468 17550	.62 .62	20:18:32 20:19:02	.52 .52	.0276 .0276	.0314 .0314
19:50:32 7.1 -31.4	.0023 .0375	.0023 .0375	.0023 .0375	80 80	0142 1433	2468 1433	2468 1433	.59 .59	20:19:02 20:19:32	.52 .52	.0276 .0276	.0314 .0314
19:51:02 7.1 -31.4	.0020 .0372	.0020 .0372	.0020 .0372	87 87	0147 1433	2468 33160	2468 743	.64 .64	20:19:32 20:20:02	.52 .52	.0276 .0276	.0314 .0314
19:51:32 7.1 -31.5	.0019 .0374	.0019 .0374	.0019 .0374	84 84	0119 1433	2468 1433	2468 1433	.44 .44	20:20:02 20:20:32	.52 .52	.0276 .0276	.0314 .0314
19:52:02 7.1 -31.4	.0021 .0375	.0021 .0375	.0021 .0375	82 82	0121 1433	2468 27492	2468 27492	.51 .51	20:20:32 20:21:02	.52 .52	.0276 .0276	.0314 .0314
19:52:32 7.1 -31.8	.0017 .0378	.0017 .0378	.0017 .0378	79 79	0121 1433	2468 1908	2468 1908	.49 .49	20:21:02 20:21:32	.52 .52	.0276 .0276	.0314 .0314
19:53:02 7.1 -31.7	.0018 .0374	.0018 .0374	.0018 .0374	77 77	0148 1433	2468 1908	2468 1908	.65 .65	20:21:32 20:22:02	.52 .52	.0276 .0276	.0314 .0314
19:53:32 7.1 -31.7	.0015 .0374	.0015 .0374	.0015 .0374	75 75	0142 1433	2468 1433	2468 1433	.59 .59	20:22:02 20:22:32	.52 .52	.0276 .0276	.0314 .0314
19:54:02 7.1 -31.4	.0017 .0375	.0017 .0375	.0017 .0375	72 72	0147 1433	2468 1433	2468 1433	.59 .59	20:22:32 20:23:02	.52 .52	.0276 .0276	.0314 .0314
19:54:32 7.1 -31.4	.0016 .0374	.0016 .0374	.0016 .0374	70 70	0118 1433	2468 1433	2468 1433	.59 .59	20:23:02 20:23:32	.52 .52	.0276 .0276	.0314 .0314
19:55:02 7.1 -31.8	.0015 .0378	.0015 .0378	.0015 .0378	67 67	0119 1433	2468 1433	2468 1433	.59 .59	20:23:32 20:24:02	.52 .52	.0276 .0276	.0314 .0314
19:55:32 7.1 -31.7	.0017 .0375	.0017 .0375	.0017 .0375	65 65	0119 1433	2468 1433	2468 1433	.59 .59	20:24:02 20:24:32	.52 .52	.0276 .0276	.0314 .0314
19:56:02 7.1 -32.0	.0014 .0374	.0014 .0374	.0014 .0374	53 53	0120 1433	2468 1433	2468 1433	.59 .59	20:24:32 20:25:02			

24 MAR 78												30 SEC AVERAGE												
START	ALT	TEMP	LUC-SC	LUC-101	LUC	DO	CLD	UR	NT	N/N+3	UH	LMX	FF	FF	LMX	FF	LMX	FF	LMX	FF	LMX	FF		
TIME	KM	C	B/H+3	B/H+3	x CLD							UH	UH	UH	UH	UH	UH	UH	UH	UH	UH	UH	UH	
20:20:31	5.4	-20.4	.0061	.0060	0	0	0	0	0	0	4	0.00	0.00	0.00	20:54:31	3.4	-4.9	0.002	0.281	7	982	1243	2123	-21
20:21:01	5.4	-20.0	.0013	.0013	0	0	0	0	0	0	10	0.00	0.00	0.00	20:55:01	3.4	-6.3	0.008	0.407	1	1101	1543	2813	-31
20:22:31	5.4	-19.4	.0145	.0001	79	134	121	243	.55	20:55:31	3.3	-5.7	0.051	0.1302	1	1140	1543	2813	30					
20:23:01	5.4	-19.7	.0058	.0013	20	218	571	1088	.51	20:56:01	3.2	-5.7	0.017	0.2334	6	1331	1379	3503	66					
20:23:31	5.4	-19.4	.0061	.0005	33	211	147	1088	.61	20:56:31	3.0	-4.9	0.048	0.2249	2	1343	1379	3503	66					
20:24:01	5.4	-19.7	.0014	.0140	14	242	4946	2123	.45	20:57:01	2.8	-4.2	0.0279	0.2123	7	1240	5659	3844	-65					
20:24:31	5.4	-19.8	.0031	.0031	13	281	3823	2468	.52	20:57:31	3.0	-4.4	0.0225	0.0833	0	1128	1169	3208	2448	-29				
20:29:01	5.4	-19.4	.0026	.0026	16	274	7257	2813	.40	20:58:01	3.0	-4.6	0.0227	0.0581	1	1169	1326	2448	13					
20:30:31	5.4	-19.4	.0031	.0020	15	290	9418	3503	.36	20:58:31	3.0	-4.7	0.0494	0.0853	5	1282	1374	3159	66					
20:31:01	5.4	-19.7	.0058	.0058	20	249	2486	34	.34	20:59:01	3.0	-4.7	0.0219	0.1204	15	1345	1216	3503	63					
20:31:31	5.4	-20.1	.0028	.0030	17	305	1698	2813	.25	20:59:31	3.0	-4.7	0.0114	0.0907	14	1284	6479	3159	-63					
20:32:01	5.4	-20.1	.0079	.0049	14	296	2912	2123	.27	21:00:01	3.0	-4.8	0.0587	0.0444	29	1058	4784	2132	-63					
20:32:31	5.4	-20.1	.0002	.0004	33	210	1088	171	.57	21:00:31	3.0	-5.0	0.0720	0.0305	43	438	3761	1835	-66					
20:33:01	5.4	-19.7	.0001	.0000	0	0	0	0	0	0	21:01:01	3.0	-5.1	0.0940	0.0312	16	1479	1640	3023	-62				
20:33:31	5.4	-19.7	.0001	.0061	72	149	32	1088	.54	21:01:31	3.0	-5.0	0.0941	0.1073	2	1239	4490	2429	13					
20:34:01	5.4	-20.3	.0002	.0009	45	193	1522	1433	.28	21:02:01	3.0	-4.9	0.0337	0.0869	4	1622	6367	1835	-14					
20:34:31	5.4	-20.9	.0010	.0093	43	182	4043	1726	.49	21:02:31	3.0	-4.7	0.0568	0.0791	4	990	5523	1835	-14					
20:35:01	5.4	-21.3	.0023	.0017	26	229	10075	2630	.41	21:03:01	3.0	-4.7	0.0846	0.1187	3	1005	5689	2726	-68					
20:35:31	5.4	-21.2	.0015	.0159	22	237	4685	2469	.41	21:03:31	3.0	-4.7	0.1362	0.1146	3	882	5699	2132	-18					
20:36:01	5.4	-21.1	.0022	.0026	24	239	13745	2649	.37	21:04:01	3.0	-4.9	0.1267	0.2449	1	926	7240	3417	-14					
20:36:31	5.4	-20.7	.0044	.0046	17	260	15736	2813	.40	21:04:31	3.0	-5.0	0.1387	0.0961	3	905	6488	2726	-11					
20:37:01	5.4	-20.4	.0046	.0047	13	284	17143	2468	.38	21:05:01	3.0	-5.3	0.1438	0.0897	3	1262	2673	4506	-64					
20:37:31	5.4	-20.3	.0052	.0052	6	321	13424	2013	.39	21:05:31	3.0	-5.4	0.1327	0.0547	5	927	3501	1835	-14					
20:38:01	5.4	-20.3	.0040	.0040	5	334	1224	3046	.34	21:06:01	3.0	-5.4	0.0970	0.0427	3	1127	2773	2726	-12					
* 20:38:31	5.4	-20.4	.0054	.0054	5	333	11608	2013	.32	21:06:31	3.0	-5.4	0.0604	0.0544	3	1104	2341	2132	-16					
* 20:39:01	5.4	-20.5	.0062	.0075	4	327	14629	2469	.38	21:07:01	3.0	-5.3	0.0291	0.1102	1	1749	3379	3329	-67					
* 20:39:31	5.4	-20.5	.0050	.0050	4	344	1295	2628	.43	21:07:31	3.0	-5.4	0.0891	0.1552	1	949	3418	3623	-16					
* 20:40:01	5.4	-20.4	.0046	.00587	4	335	10715	2113	.44	* 21:08:01	3.0	-5.3	0.0647	0.1540	6	1451	1137	5229	-17					
20:40:31	5.4	-20.8	.0067	.0070	4	340	14203	2013	.42	* 21:08:31	3.0	-5.2	0.1049	0.1914	6	1049	5226	1995	-16					
20:41:01	5.4	-21.0	.0084	.0107	4	340	19428	3159	.43	* 21:09:01	3.0	-5.2	0.0947	0.1397	1	2995	9385	3226	-12					
20:41:31	5.4	-21.1	.0058	.0071	5	324	15060	2013	.32	* 21:09:31	3.0	-5.1	0.0919	0.1215	6	1192	15318	5226	-22					
20:42:01	5.4	-21.2	.0078	.0083	4	318	20819	2013	.40	* 21:10:01	3.0	-5.1	0.0604	0.0844	3	1104	2341	2132	-16					
20:42:31	5.4	-21.2	.0078	.0080	4	319	21244	2160	.38	* 21:10:31	3.0	-4.8	0.0677	0.2794	6	1584	33802	5226	-19					
20:43:01	5.4	-21.4	.0068	.00829	5	323	20522	2113	.40	* 21:11:01	3.0	-5.4	0.0645	0.0921	32	271	2391	4483	-27					
20:43:31	5.4	-21.7	.0051	.00612	4	331	12620	3159	.42	* 21:11:31	3.0	-4.8	0.0643	0.0922	51	45	4483	4983	-29					
20:44:01	5.4	-21.8	.0036	.0498	4	323	9164	2648	.48	* 21:12:01	3.0	-4.8	0.0644	0.1176	54	42	2465	4663	-32					
20:44:31	5.4	-21.7	.0039	.0498	4	308	9426	2648	.46	* 21:12:31	3.0	-4.7	0.0642	0.0619	58	62	1887	4683	-35					
20:45:01	5.4	-21.6	.0039	.0354	10	2808	12068	2648	.41	* 21:13:01	3.0	-5.0	0.0604	0.2031	3	1411	3451	5226	-67					
20:45:31	5.4	-21.7	.0040	.0339	13	275	13810	2648	.42	* 21:13:31	3.0	-5.0	0.0644	0.1966	9	733	4192	5226	-10					
20:46:01	5.4	-21.5	.0044	.0445	12	292	12545	4193	.38	* 21:14:01	3.0	-4.9	0.0643	0.3018	5	677	4186	5226	-14					
20:46:31	5.4	-21.3	.0044	.03556	4	337	10837	2488	.39	* 21:14:31	3.0	-5.0	0.0643	0.0641	5	770	41815	4538	-16					
20:47:01	5.4	-20.9	.0056	.00845	1	1054	12379	3503	.33	* 21:15:01	3.0	-5.1	0.0623	0.1279	4	524	20977	5226	-16					
20:47:31	5.4	-20.4	.0054	.00546	1	1064	13798	2013	.33	* 21:15:31	3.0	-5.1	0.0614	0.0410	5	427	1657	4663	-23					
20:48:01	5.4	-19.4	.0040	.00541	2	1067	18900	5228	.40	* 21:16:01	3.0	-5.2	0.0604	0.0614	5	1673	13264	4538	-22					
20:48:31	5.4	-18.8	.0052	.00447	1	1179	47	21169	.32	* 21:16:31	3.0	-5.3	0.0604	0.0614	7	1535	26875	5226	-67					
20:49:01	5.4	-17.4	.0040	.0039	12	1111	15344	4193	.32	* 21:17:01	3.0	-5.4	0.0604	0.0649	10	1184	12211	4663	-14					
20:49:31	5.4	-16.3	.0039	.00418	1	1085	8477	3503	.35	* 21:17:31	3.0	-5.5	0.0604	0.0649	5	1135	27995	5226	-13					
20:50:01	5.4	-14.7	.0021	.02574	7	916	5177	2813	.29	* 21:18:01	3.0	-5.5	0.0604	0.0641	24	273	20797	4663	-20					
20:50:31	5.4	-14.1	.0001	.0029	10	943	217	1778	.15	* 21:18:31	3.0	-5.5	0.0604	0.1269	12	1369	3799	4663	-19					
20:51:01	5.4	-13.2	.0052	.0072	39	403	1179	47	2123	* 21:19:01	3.0	-5.7	0.0604	0.2237	16	1334	4663	5226	-18					
20:51:31	4.4	-12.1	.0012	.00447	1	1111	15344	4193	.32	* 21:19:31	3.0	-5.7	0.0604	0.0649	7	1535	26875	5226	-67					
20:52:01	4.4																							

24 MAR 78										30 SECOND AVERAGE										30 SECOND AVERAGE									
START	ALT	TEMP	LUC-TOT	LUC-SC	LUC-Meas3	6/1000+3	DO	NT	LMAX	FF	START	ALT	TEMP	LUC-TOT	LUC-SC	LUC-Meas3	6/1000+3	DO	NT	LMAX	FF								
*	21:22:31	3.0	-5.7	.0000	.1428	12	245	51154	53115	.41	*	21:50:101	1.5	-1.5	.0000	.2336	3	930	1350	5228	.14								
*	21:23:01	3.0	-5.4	.0000	.1536	9	272	49273	60803	.39	*	21:50:31	1.5	-1.0	.0000	.2994	3	906	17634	5228	.14								
*	21:23:31	3.0	-5.3	.0000	.1402	7	281	40577	60803	.35	*	21:51:06	1.5	-1.0	.0000	.3592	3	866	19805	5228	.24								
*	21:24:01	3.0	-5.4	.0000	.1365	8	264	41643	60803	.38	*	21:51:31	1.5	-1.7	.0002	.2817	3	874	15977	5228	.14								
*	21:24:31	3.0	-5.3	.0000	.1429	4	287	30678	60803	.38	*	21:52:01	1.5	-1.7	.0000	.2516	2	881	12718	5228	.24								
*	21:25:01	3.0	-4.9	.0000	.1190	3	287	21953	60803	.45	*	21:52:31	1.5	-1.7	.0000	.2523	3	885	13971	5228	.14								
*	21:25:31	3.0	-4.1	.0000	.1500	2	364	19895	60803	.36	*	21:53:01	1.5	-1.9	.0000	.2529	1	944	13642	5228	.14								
*	21:26:01	3.0	-6.0	.0000	.0803	4	280	16142	60803	.40	*	21:53:31	1.5	-2.0	.0001	.1870	2	941	8736	5228	.14								
*	21:26:31	3.0	-5.9	.0000	.0783	2	284	13644	5697	.34	*	21:54:01	1.5	-1.9	.0010	.1497	3	1038	7932	5228	.17								
*	21:27:01	2.9	-5.4	.0000	.1194	3	312	19178	60803	.42	*	21:54:31	1.5	-1.9	.0020	.1371	4	993	16132	5228	.14								
*	21:27:31	2.8	-4.8	.0000	.1257	3	324	21767	60803	.36	*	21:55:01	1.5	-1.4	.0019	.1219	1	991	7399	5228	.14								
*	21:28:01	2.6	-4.4	.0000	.3449	2	276	17104	5228	.22	*	21:55:31	1.4	-1.4	.0032	.1482	5	935	16912	5228	.15								
*	21:28:31	2.5	-4.9	.0000	.3572	2	862	18854	5228	.19	*	21:56:01	1.4	-1.4	.0012	.1482	5	948	12897	5228	.14								
*	21:29:01	2.4	-5.9	.0000	.3161	2	919	17448	5228	.18	*	21:56:31	1.4	-1.7	.0004	.1469	4	981	16197	5228	.15								
*	21:29:31	2.3	-5.6	.0000	.3923	2	857	21659	5228	.19	*	21:57:01	1.4	-1.4	.0011	.1329	4	921	9116	5228	.14								
*	21:30:01	2.2	-5.2	.0000	.5158	3	806	30356	5228	.19	*	21:57:31	1.4	-1.5	.0020	.1323	4	722	11952	5228	.14								
*	21:30:31	2.1	-2.8	.0000	.3996	3	753	24105	5228	.19	*	21:58:01	1.5	-1.4	.0051	.1221	5	834	9575	5228	.14								
*	21:31:01	2.1	-3.0	.0000	.3225	4	756	22125	5228	.19	*	21:58:31	1.5	-1.9	.0078	.1337	6	828	11278	5228	.14								
*	21:31:31	2.1	-3.3	.0000	.2416	6	782	24596	5228	.15	*	21:59:01	1.5	-1.9	.0081	.1470	5	819	11490	5228	.17								
*	21:32:01	2.1	-3.0	.0000	.2238	4	751	18799	5228	.17	*	21:59:31	1.5	-1.9	.0105	.1235	5	738	10453	5228	.19								
*	21:32:31	2.0	-2.3	.0000	.2108	7	708	20793	5228	.16	*	21:00:01	1.5	-1.7	.0136	.1465	4	702	6145	5228	.20								
*	21:33:01	1.9	-2.1	.0000	.1752	10	480	21500	5228	.21	*	21:00:31	1.5	-2.0	.0137	.0950	4	745	6274	5228	.18								
*	21:33:31	1.7	-2.3	.0000	.1137	14	335	20000	4683	.21	*	21:01:01	1.5	-2.0	.0137	.0950	4	745	6274	5228	.18								
*	21:34:01	1.6	-2.5	.0000	.0825	11	338	13049	4893	.21	*	21:01:31	1.4	-1.8	.0098	.0750	5	688	7577	5228	.17								
*	21:34:31	1.5	-2.5	.0000	.0864	9	393	11040	5228	.20	*	21:02:01	1.5	-2.0	.0160	.0851	5	619	8098	5228	.23								
*	21:35:01	1.5	-2.3	.0000	.1024	6	451	12139	5228	.19	*	21:02:31	2.2	-2.4	.0212	.0976	4	652	7956	5228	.21								
*	21:35:31	1.5	-2.5	.0000	.0964	7	375	13604	5228	.19	*	21:03:01	2.4	-3.0	.0320	.0977	5	597	9797	5228	.22								
*	21:36:01	1.5	-2.1	.0000	.0764	9	340	12941	5228	.20	*	21:03:31	2.7	-2.7	.0498	.1077	4	217	43617	4193	.04								
*	21:36:31	1.4	-2.4	.0000	.0646	6	340	11292	5228	.20	*	21:04:01	3.1	-3.3	.0447	.1064	4	499	16449	4883	.20								
*	21:37:01	1.4	-2.2	.0000	.0812	4	369	12216	4893	.32	*	21:04:31	3.1	-6.3	.0405	.1129	7	338	20027	4539	.27								
*	21:37:31	1.4	-2.4	.0000	.0907	4	432	8883	4893	.31	*	21:05:01	3.1	-6.9	.0422	.0642	15	298	11386	5228	.17								
*	21:38:01	1.5	-2.4	.0000	.1022	5	395	12139	5053	.36	*	21:05:31	3.4	-7.4	.0592	.0337	10	222	15035	3158	.21								
*	21:38:31	1.5	-2.5	.0000	.1088	5	369	13134	3158	.38	*	21:06:01	3.7	-7.9	.0439	.0637	4	693	43617	4193	.04								
*	21:39:01	1.5	-2.2	.0000	.0894	6	368	10394	5228	.28	*	21:06:31	3.7	-8.4	.0391	.0029	1	691	350	3158	.34								
*	21:39:31	1.5	-1.7	.0000	.0947	6	383	12001	4893	.26	*	22:01:01	4.0	-9.5	.0245	.0581	121	3848	171	3848	.25								
*	21:40:01	1.5	-1.4	.0003	.0542	8	357	9202	4539	.30	*	22:01:31	4.2	-10.3	.0377	.0016	12	454	1640	2164	.11								
*	21:40:31	1.5	-1.3	.0000	.1872	2	905	5991	4893	.27	*	22:02:01	4.3	-11.5	.0227	.0051	67	44	1641	1908	.08								
*	21:41:01	1.5	-1.4	.0005	.0346	7	332	5244	4193	.30	*	22:02:31	4.5	-12.7	.0118	.0092	77	16	2745	445	.21								
*	21:41:31	1.5	-1.1	.0000	.2884	6	481	6316	4536	.27	*	22:03:01	4.4	-13.7	.0090	.0090	0	0	0	0	0								
*	21:42:01	1.5	-1.3	.0000	.1196	4	622	9481	5228	.23	*	22:03:31	4.8	-14.3	.0090	.0090	0	0	0	0	0								
*	21:42:31	1.5	-1.3	.0000	.1459	2	697	7877	5228	.23	*	22:04:01	5.0	-16.1	.0060	.0060	0	0	0	0	0								
*	21:43:01	1.5	-1.2	.0000	.2231	3	714	1943	5228	.19	*	22:04:31	5.0	-16.1	.0060	.0060	0	0	0	0	0								
*	21:43:31	1.4	-1.6	.0000	.3504	4	786	24973	5228	.18	*	22:05:01	5.0	-16.1	.0060	.0060	0	0	0	0	0								
*	21:44:01	1.5	-1.4	.0000	.4636	4	346	3092	4893	.27	*	22:05:31	5.0	-16.1	.0060	.0060	0	0	0	0	0								
*	21:44:31	1.4	-1.4	.0001	.3422	4	1042	12477	5228	.17	*	22:06:01	5.0	-16.1	.0060	.0060	0	0	0	0	0								
*	21:45:01	1.5	-1.3	.0001	.2812	4	1004	20761	5228	.15	*	22:06:31	5.0	-16.1	.0060	.0060	0	0	0	0	0								
*	21:45:31	1.4	-1.2	.0000	.2677	2	910	26339	5228	.15	*	22:07:01	5.0	-16.1	.0060	.0060	0	0	0	0	0								
*	21:46:01	1.4	-1.3	.0000	.1879	5	823	17475	5228	.15	*	22:07:31	5.0	-16.1	.0060	.0060	0	0	0	0	0								
*	21:46:31	1.5	-1.3	.0000	.2027	4	916	13833	5228	.14	*	22:08:01	5.0	-16.1	.0060	.0060	0	0	0	0	0								

START	ALT	TEMP	25 MAR 78			30 SECOND AVERAGE			25 MAR 78			30 SECOND AVERAGE			25 MAR 78					
			LWC-SC	LWC-TOT	LWC	IN	INT	LMAX	ALT	TIME	IN	LWC-SC	LWC-TOT	LWC	IN	INT	LMAX	FF		
TIME	MIN	C	B/H ^{0.3}	B/H ^{0.3}	CLB	UN	B/H ^{0.3}	UN	C	B/H ^{0.3}	B/H ^{0.3}	CLB	UN	B/H ^{0.3}	CLB	UN	B/H ^{0.3}			
1750113	7.2	-32.4	.0009	.0002	.95	160	.972	243	.38	* 16191913	7.3	-33.1	.0152	.20	.147	12327	1088	.43		
1750113	7.1	-32.3	.0002	.0006	.59	209	.5965	1278	.65	* 16191913	7.3	-33.0	.0114	.017	.127	11673	1088	.40		
1751113	7.2	-32.5	.0023	.0127	.73	161	13378	1433	.37	* 16191913	7.3	-33.0	.0017	.0228	.62	172	1088	.42		
1751143	7.2	-32.4	.0024	.0139	.81	152	14213	1433	.62	* 16191913	7.3	-32.9	.0012	.0114	.48	182	9348	1088	.56	
1752113	7.2	-32.4	.0026	.0114	.24	162	10519	1033	.69	[16192013	7.3	-32.0	.0028	.0120	.52	179	6357	1088	.54	
1752143	7.2	-32.4	.0017	.0115	.56	174	.7725	1728	.66	[16192013	7.1	-30.5	.0010	.0111	.56	175	6402	1088	.44	
1753113	7.2	-32.2	.0021	.0190	.47	185	12880	1780	.54	[16192113	6.9	-29.4	.0010	.0095	.50	179	6837	1088	.56	
1753143	7.2	-32.0	.0024	.0270	.66	170	21696	1688	.60	[16192113	6.8	-28.7	.0008	.0088	.56	175	6259	1088	.57	
1754113	7.2	-32.6	.0020	.0181	.82	142	16445	743	.45	[16192213	6.7	-28.1	.0012	.0060	.48	182	4144	1088	.57	
1754143	7.2	-32.2	.0024	.0070	.65	157	4178	743	.69	[16192213	5.9	-22.4	.0007	.0069	.60	172	5218	1433	.57	
1755113	7.2	-32.3	.0014	.0034	.47	184	.2772	1888	.51	[16192313	6.4	-26.3	.0013	.0112	.41	193	5678	1433	.49	
1755143	7.2	-32.3	.0016	.0031	.45	189	.1897	1888	.37	[16192313	6.3	-25.7	.0009	.0074	.45	168	3176	1433	.46	
1756113	7.2	-32.3	.0031	.0249	.19	244	2045	1688	.35	[16192413	6.2	-24.6	.0014	.0024	.60	168	3185	1433	.40	
1756143	7.1	-32.0	.0032	.0047	.15	220	3323	1788	.36	[16192413	6.1	-23.5	.0008	.0025	.70	164	1932	743	.64	
1757113	7.1	-31.6	.0049	.0012	.18	258	540	1688	.47	[16192513	5.9	-22.4	.0008	.0073	.59	172	420	1088	.67	
1757143	7.0	-31.1	.0013	.0117	.74	168	6511	1088	.68	[16192513	5.8	-21.6	.0007	.0069	.60	172	3964	1088	.48	
1758113	7.1	-31.3	.0003	.0020	.72	148	1429	743	.48	[16192613	5.7	-20.8	.0007	.0039	.35	203	1914	1088	.57	
1758143	7.1	-31.5	.0003	.0033	.48	176	.535	1088	.46	[16192613	5.4	-20.2	.0007	.0038	.30	211	1543	1088	.41	
1759113	7.2	-31.8	.0002	.0005	.28	217	123	1088	.69	[16192713	5.6	-20.3	.0007	.0052	.20	236	2004	1433	.54	
1759143	7.2	-32.3	.0001	.0004	.59	174	.193	277	.743	[16192713	5.4	-20.1	.0012	.0170	.8	290	3575	1778	.56	
1800113	7.3	-32.6	.0001	.0004	.65	148	.226	1688	.66	[16192813	5.4	-20.0	.0013	.0137	.9	296	3550	1778	.54	
1800143	7.3	-33.1	.0001	.0009	.72	148	.522	743	.74	[16192813	5.4	-19.9	.0018	.0313	6	304	5530	2464	.51	
1801113	7.3	-33.1	.0001	.0001	.47	62	.173	743	.47	[16192913	5.4	-19.8	.0015	.0215	.8	301	5227	2464	.49	
1801143	7.3	-33.0	.0001	.0011	.98	158	.1376	465	.65	[16192913	5.4	-19.7	.0033	.0279	.11	286	12349	2464	.49	
1802113	7.3	-32.8	.0001	.0004	.84	118	.538	243	.70	[16193013	5.4	-19.8	.0022	.0280	.22	237	9592	2464	.53	
1802143	7.3	-32.7	.0001	.0007	.46	151	.822	348	.71	[16193013	5.4	-19.9	.0014	.0211	.60	197	9317	1778	.41	
1803113	7.3	-32.6	.0002	.0029	.98	158	.2943	465	.70	[16193113	5.6	-19.7	.0010	.0160	.55	175	8940	1088	.65	
1803143	7.3	-32.5	.0003	.0043	.92	162	.5384	743	.56	[16193113	5.6	-19.9	.0007	.0081	.44	191	4042	1778	.57	
1804113	7.3	-32.4	.0009	.0079	.65	149	.795	1088	.55	[16193213	5.6	-19.9	.0007	.0067	.50	294	1778	1433	.53	
1804143	7.3	-32.8	.0008	.0036	.47	184	.254	1088	.53	[16193213	5.6	-19.9	.0001	.0000	0	294	1778	1433	.53	
1805113	7.3	-32.7	.0005	.0023	.44	189	.2245	1088	.44	[16193313	5.6	-20.2	.0001	.0000	0	296	12349	2464	.49	
1805143	7.3	-32.8	.0004	.0021	.46	187	.1455	1088	.53	[16193313	5.6	-20.8	.0001	.0000	0	23	210	1778	.41	
1806113	7.3	-32.9	.0005	.0018	.36	200	.2024	1088	.59	[16193413	5.6	-20.7	.0001	.0000	0	0	4	1778	.48	
1806143	7.3	-33.0	.0002	.0044	.29	178	.4457	1314	.57	[16193413	5.6	-20.9	.0001	.0000	0	0	4	1778	.48	
1807113	7.3	-33.1	.0012	.0040	.11	237	.3610	1314	.41	[16193513	5.6	-21.4	.0002	.0004	.4	0	4	1778	.44	
1807143	7.3	-33.2	.0010	.0058	.11	235	.4286	1316	.35	[16193513	5.6	-21.2	.0001	.0000	0	0	4	1778	.42	
1808113	7.3	-33.1	.0003	.0004	.54	137	.1052	706	.49	[16193613	5.6	-21.3	.0000	.0000	0	0	4	1778	.42	
1808143	7.3	-33.0	.0007	.0015	.39	162	.2978	1011	.35	[16193613	5.6	-21.3	.0001	.0000	0	0	4	1778	.42	
1809113	7.3	-33.0	.0011	.0072	.32	172	.9277	.36	[16193713	5.6	-21.4	.0001	.0002	.73	162	146	743	.73		
1809143	7.3	-32.9	.0014	.0187	.27	189	.8559	1316	.47	[16193713	5.6	-21.4	.0001	.0004	.73	244	2814	743	.72	
1810113	7.3	-33.0	.0017	.0181	.7	289	.8641	1422	.36	[16193813	5.6	-21.4	.0002	.0017	.73	154	1381	1088	.44	
1810143	7.3	-33.2	.0016	.0136	.29	180	.16493	1622	.37	[16193813	5.6	-21.4	.0004	.0004	.68	164	3215	1088	.42	
1811113	7.3	-33.1	.0017	.0165	.36	164	.17187	1314	.46	[16193913	5.6	-21.2	.0001	.0004	.75	164	546	743	.52	
1811143	7.3	-33.0	.0003	.0004	.54	137	.1052	706	.49	[16193913	5.6	-21.3	.0003	.0004	.44	190	1894	445	.52	
1812113	7.3	-32.9	.0006	.0014	.67	127	.3910	.704	.47	[16194013	5.6	-21.3	.0001	.0000	0	0	139	4320	743	.71
1812143	7.3	-33.1	.0005	.0013	.97	114	.3278	.437	.64	[16194013	5.6	-21.2	.0004	.0038	.82	152	2814	743	.74	
1813113	7.3	-32.8	.0011	.0021	.81	129	.5646	704	.61	[16194113	5.6	-21.0	.0008	.0004	.84	144	593	743	.54	
1813143	7.3	-32.9	.0005	.0020	.69	127	.3169	1011	.57	[16194113	5.6	-21.0	.0008	.0077	.31	213	3172	1778	.53	
1814113	7.3	-32.9	.0007	.0028	.42	135	.4798	704	.36	[16194213	5.6	-21.1	.0009	.0113	.39	198	4897	1778	.59	
1814143	7.3	-32.8	.0010	.0195	.61	164	.11990	743	.42	[16194213	5.6	-20.7	.0002	.0012	.44	190	598	1433	.57	
1815113	7.3	-32.9	.0013	.0154	.82	161	.14918	743	.64	[16194313	5.6	-20.4	.0001	.0000	0	0	217	1445	1088	.46
1815143	7.3	-32.8	.0011	.0150	.83	162	.13874	743	.65	[16194313	5.6	-20.7	.0002	.0011	.55	175	1089	1088	.44	
1816113	7.3	-32.9	.0010	.0121	.84	163	.11777	1608	.63	[16194413	5.6	-20.7	.0001	.0004	.84	144	593	743	.54	
1816143	7.3	-32.9	.0008	.0074	.93	146	.8426	743	.71	[16194413	5.6	-20.4	.0001	.0000	0	0	6	0.00	0	
1817113	7.3	-33.0	.0007	.0095	.98	151	.9960	.445	.68	[16194513	5.6	-20.4	.0001	.0000	0	0	0	0.00	0	
1817143	7.3	-33.1	.0006	.0081	.66	164	.2778	.243	.42	[16194513	5.6	-20.2	.0001	.0000	0	0	0	0.00	0	

START	ALT	25 SEC			30 SEC			AVERAGE			30 SEC			AVERAGE							
		TEMP	LNC-SC	LNC-107 LNC	TIME	TEMP	LNC-SC	LNC-107 LNC	TIME	HT	LMAX	HT	WT	LMAX	HT	WT					
18106113	5.5	-19.4	.0001	0.0000	0	10	0.00	191411	2.9	-4.3	.0000	-101	24	126	7306	2132	.03				
18106143	5.5	-18.4	.0001	0.0000	0	0	18	0.00	191413	2.9	-4.2	.0000	-103	13	912	1444	2429	.06			
18107113	5.2	-17.5	.0001	0.0000	0	0	14	0.00	191513	2.9	-4.1	.0000	-102	11	1131	888	2132	.10			
18107143	5.1	-16.2	.0001	0.0000	0	4	0.00	1915143	2.9	-4.2	.0000	-103	14	1019	1549	2429	.06				
18108113	4.7	-15.1	.0001	0.0000	0	0	4	0.00	1916113	2.9	-4.2	.0000	-103	16	1083	2132	.06				
18108143	4.7	-14.1	.0001	0.0000	0	0	4	0.00	1916143	2.9	-4.3	.0000	-105	2	1789	2132	.04				
18109113	4.4	-13.1	.0000	0.0000	0	0	4	0.00	1917113	2.9	-4.3	.0000	-119	2	1899	2726	.07				
18109143	4.4	-12.3	.0001	0.0000	0	0	4	0.00	1917143	2.9	-4.3	.0000	-102	12	1073	5787	2429	.03			
18150113	4.3	-11.4	.0001	0.0000	0	0	4	0.00	* 1918113	2.9	-4.4	.0000	-103	14	1144	2132	.03				
18150143	4.3	-10.4	.0001	0.0000	0	30	0.00	* 1918143	2.9	-4.4	.0000	-101	16	1284	1834	1835	.02				
18151113	3.9	-9.5	.0014	0.0000	0	0	30	0.00	* 1919113	2.9	-4.3	.0000	-101	21	1888	2957	2132	.02			
18151143	3.9	-8.7	.0029	0.0000	0	0	30	0.00	* 1919143	2.9	-4.2	.0000	-102	12	1242	2354	2224	.01			
18152113	3.6	-7.9	.1349	.0000	0	10	0.00	1920113	2.9	-3.9	.0000	-105	19	1268	7142	1835	.02				
18152143	3.6	-6.5	.0209	.0000	0	277	1.538	1.13	1920143	2.9	-4.1	.0000	-103	17	991	2051	2132	.02			
18153113	3.2	-5.3	.0022	.0000	0	44	.347	.9358	1.04	1921113	2.9	-4.2	.0000	-102	2	2687	3023	2132	.02		
18153143	3.1	-4.0	.0001	.0000	0	64	.188	.4320	1.241	1921143	3.0	-4.3	.0000	-103	1	2670	5226	3320	.02		
18154113	3.0	-3.5	.0055	.0000	0	33	.827	.1241	1922113	3.0	-4.5	.0000	-101	1	2948	8057	3320	.02			
18154143	3.0	-3.1	.0027	.0000	0	32	.484	.39489	1.538	0.02	1922143	3.0	-4.4	.0000	-101	9	1253	6611	2429	.02	
18155113	2.9	-2.0	.0150	.0000	0	46	.455	.16306	1.241	.02	1923113	3.0	-4.4	.0000	-101	14	803	3035	1538	.11	
18155143	2.9	-2.7	.0021	.0000	0	1811	.25831	.2429	0.01	1923143	3.0	-4.2	.0000	-104	2	1345	941	2726	.07		
18156113	2.9	-2.7	.0009	.0000	0	180	.182	.27	1.81	1.00	1924113	3.0	-4.0	.0000	-106	4	1044	2355	2132	.19	
18156143	2.9	-3.0	.0023	.0000	0	21	.2054	.9154	2.135	.01	1924143	2.9	-3.8	.0000	-103	0	592	3969	4193	.22	
18157113	2.9	-3.2	.0045	.0000	0	40	.30417	.3086	3.0417	1.241	0.02	1925113	2.7	-3.2	.0000	-105	1	630	3460	4883	.25
18157143	2.9	-3.4	.0026	.0000	0	39	.380	.46211	1.538	.05	1925143	2.5	-2.8	.0000	-104	3	608	1321	4539	.22	
18158113	2.9	-3.5	.1367	.0000	0	45	.1633	.16306	1.241	.02	1926113	2.4	-2.4	.0000	-104	2	607	9379	4883	.27	
18158143	2.9	-3.7	.1367	.0000	0	42	.377	.10850	.281	.01	1926143	2.3	-2.5	.0000	-104	3	639	12008	5228	.24	
18159113	2.9	-3.7	.1458	.0000	0	49	.321	.16719	.2734	.02	1927113	2.2	-2.2	.0000	-104	2	626	9097	5228	.28	
18159143	2.9	-3.7	.1818	.0000	0	48	.318	.280024	.2132	.03	1927143	2.0	-2.8	.0000	-104	4	589	9922	4083	.26	
19100113	2.9	-3.7	.1670	.0000	0	48	.342	.238339	.2129	.01	1928113	1.9	-3.4	.0000	-104	5	538	8112	4538	.25	
19100143	2.9	-3.8	.1503	.0000	0	36	.611	.208240	.2274	.01	1928143	1.8	-4.1	.0000	-107	5	509	4735	5228	.25	
19101113	2.9	-3.5	.1367	.0000	0	41	.202	.212526	.2132	.03	1929113	1.6	-4.3	.0000	-102	7	529	8605	4193	.30	
19101143	2.9	-3.8	.1281	.0000	0	43	.1645	.10850	.281	.02	1929143	1.5	-4.8	.0000	-104	4	549	8069	4538	.27	
19102113	2.9	-3.7	.1369	.0000	0	54	.220	.19135	.1835	.01	1930113	1.4	-4.5	.0002	-1571	3	721	9204	4883	.24	
19102143	2.9	-3.7	.1452	.0000	0	52	.1641	.13398	.1539	.01	1930143	1.4	-4.7	.0003	-102	3	635	12950	5228	.22	
19103113	2.9	-3.7	.1717	.0000	0	52	.1647	.151641	.1835	.02	1931113	1.4	-4.3	.0001	-107	3	617	7597	5228	.24	
19103143	2.9	-3.7	.1670	.0000	0	48	.1648	.1835	.2129	.01	1931143	1.4	-4.5	.0000	-104	5	509	4735	4883	.26	
19104113	2.9	-3.7	.1300	.0000	0	39	.584	.40122	.1835	.02	1932113	1.4	-4.4	.0000	-107	5	529	9335	5228	.25	
19104143	2.9	-3.8	.1713	.0000	0	41	.1675	.25801	.1338	.03	1932143	1.4	-4.3	.0000	-102	7	529	8605	4193	.30	
19105113	2.9	-3.7	.1013	.0000	0	43	.1645	.10850	.281	.02	1933113	1.4	-4.7	.0000	-103	21	408	2127	2468	.27	
19105143	2.9	-3.8	.0563	.0000	0	15	.1679	.1835	.1835	.01	1933143	1.4	-4.8	.0000	-104	4	491	2443	4193	.23	
19106113	3.0	-3.7	.0554	.0000	0	7	.1787	.16502	.2132	.02	1934113	1.4	-4.4	.0000	-104	22	447	2959	4193	.21	
19106143	3.0	-3.9	.0554	.0000	0	39	.1611	.16701	.2274	.01	1934143	1.4	-4.7	.0003	-102	3	620	1033	3158	.23	
19107113	3.0	-3.7	.0164	.0000	0	41	.635	.14701	.2274	.01	1935113	1.4	-4.5	.0000	-104	40	343	2032	2132	.16	
19107143	3.0	-3.8	.0530	.0000	0	61	.57	.56872	.1539	.01	1935143	1.4	-5.4	.0000	-104	47	313	654	944	.44	
19108113	3.0	-3.7	.0123	.0000	0	20	.1773	.9489	.2724	.02	1935143	1.4	-5.5	.0000	-102	54	380	1195	1241	.18	
19108143	3.0	-3.8	.0259	.0000	0	11	.2243	.19214	.3320	.01	1936113	1.4	-4.7	.0000	-102	21	283	15633	944	.15	
19109113	3.0	-3.8	.0318	.0000	0	23	.1230	.89549	.3617	.01	1936143	1.4	-4.0	.0000	-104	40	93	3303	944	.15	
19109143	3.0	-3.7	.0474	.0000	0	24	.1441	.8702	.3914	.01	1937113	1.4	-5.5	.0000	-104	73	262	14678	1538	.36	
19110113	3.0	-3.9	.0118	.0000	0	25	.780	.29226	.2724	.02	1937143	1.4	-5.8	.0000	-104	27	240	19723	2132	.16	
19110143	3.0	-3.8	.0060	.0000	0	463	.1674	.45705	.2724	.01	1938113	1.4	-5.7	.0000	-102	77	256	2074	1538	.04	
19111113	3.0	-3.7	.0318	.0000	0	17	.1812	.1873	.2132	.02	1938143	1.4	-4.8	.0000	-102	85	219	19269	1538	.41	
19111143	3.0	-3.8	.0604	.0000	0	31	.613	.8721	.3623	.03	1939113	1.4	-5.7	.0000	-102	91	211	15633	944	.44	
19112113	2.9	-4.2	.0618	.0000	0	490	.32376	.32376	.3914	.02	1939143	1.4	-5.7	.0000	-104	80	226	11234	944	.42	
19112143	2.9	-4.3	.0618	.0000	0	37	.1615	.24316	.2724	.05	1940113	1.4	-5.7	.0000	-104	75	260	16246	1835	.37	
19112213	2.9	-4.3	.0608	.0000	0	53	.301	.18901	.224	.07	1940143	1.4	-4.7	.0000	-104	82	244	18099	1538	.46	
19112243	2.9	-4.2	.0601	.0000	0	32	.472	.14710	.2429	.03	1941113	1.4	-3.9	.0000	-104	82	232	19137	1241	.52	
19112313	2.9	-4.2	.0229	.0000	0	27	.463	.12557	.2724	.03	1941143	1.4	-4.7	.0000	-104	81	241	13692	1538	.38	

START TIME	ALT MM	25 MM 78		30 SECOND AVERAGE		NT MM	LMAX MM	FF
		LUC-101	LUC-SC	LUC-101 LUC	30			
C	B/A**3	G/A**3	* CLD	UR	M/H**3	UN		
19:42:13	1.4	-3.0	.0000	.0827	.81	250	17445	.60
19:42:13	1.4	-2.9	.0001	.0764	.75	229	14995	.1835
19:43:13	1.4	-2.9	.0001	.0764	.62	258	12695	.21
19:43:13	1.4	-3.3	.0001	.0441	.78	239	13568	.1241
19:44:13	1.4	-2.2	.0001	.0504	.74	251	10974	.1538
19:44:13	1.4	-1.5	.0000	.0194	.86	187	8644	.1241
19:44:13	1.4	-1.5	.0000	.0215	.79	223	8027	.1538
19:45:13	1.5	-1.5	.0001	.0100	.45	190	5253	.21
19:45:13	1.5	-1.5	.0000	.0221	.79	249	7534	.944
19:46:13	1.5	-1.5	.0000	.0179	.85	228	6009	.647
19:46:13	1.5	-1.5	.0000	.0252	.74	229	7499	.1538
19:47:13	1.5	-1.5	.0001	.0230	.89	202	7568	.1241
19:47:13	1.5	-1.5	.0001	.0288	.72	216	2812	.1835
19:48:13	1.5	-1.5	.0000	.0100	.45	190	5253	.2132
19:48:13	1.5	-1.5	.0000	.0267	.68	248	8139	.944
19:49:13	1.5	-1.5	.0001	.0642	.53	294	13320	.2132
19:49:13	1.5	-1.5	.0001	.0209	.48	321	11829	.3023
19:50:13	1.4	-1.5	.0000	.0879	.54	301	10306	.1538
19:50:13	1.4	-1.5	.0001	.0985	.49	313	9620	.1835
19:51:13	1.5	-1.5	.0015	.0703	.22	628	9047	.2132
19:51:13	1.5	-1.5	.0075	.0243	.39	456	8610	.1538
19:52:13	1.4	-1.5	.0057	.0190	.52	284	10149	.2728
19:52:13	1.4	-1.5	.0094	.0178	.61	267	6607	.647
19:53:13	1.5	-1.5	.0196	.0217	.54	288	7982	.1241
19:53:13	1.4	-1.2	.0240	.0203	.57	222	10560	.1538
* 19:54:13	1.5	-1.2	.0073	.0322	.55	249	14187	.2429
* 19:54:13	1.4	-1.2	.0027	.0272	.57	263	11350	.2132
* 19:55:13	1.4	-1.4	.0009	.0295	.50	310	4870	.944
* 19:55:13	1.5	-1.7	.0050	.0440	.34	399	7473	.1241
19:56:13	1.5	-1.8	.0047	.0345	.47	326	12126	.2132
19:56:13	1.4	-1.3	.0046	.0406	.52	295	9548	.1538
19:57:13	1.5	-1.5	.0037	.0844	.15	756	7721	.3914
19:57:13	1.4	-1.9	.0105	.0989	.16	827	7214	.3320
19:58:13	1.4	-1.6	.0021	.1364	.30	422	14222	.1835
19:58:13	1.4	-1.8	.0027	.1050	.39	406	12638	.16
19:59:13	1.4	-2.1	.0011	.1342	.32	431	9057	.2728
19:59:13	1.4	-1.5	.0013	.1683	.47	324	15218	.1538
19:59:13	1.4	-1.4	.0023	.1613	.52	305	15644	.3023
20:00:13	1.5	-1.8	.0020	.0940	.61	228	13136	.1538
20:00:13	1.4	-1.1	.0012	.0989	.56	289	10737	.1835
20:01:13	1.4	-2.3	.0352	.21091	0	3611	28442	.4508
20:01:13	2.9	-3.3	.0134	.3636	0	3248	8689	.4508
20:01:13	1.5	-1.9	.0071	.1369	.23	462	7291	.3320
20:01:13	1.4	-1.9	.0018	.1372	.21	717	11586	.3617
20:02:13	1.4	-1.2	.0104	.4332	2	2712	8298	.4508
20:02:13	1.5	-1.7	.0059	.16212	0	3274	13450	.4508
20:03:13	2.2	-1.7	.0023	.1613	0	305	15644	.11
20:03:13	1.5	-1.4	.0254	.1899	2	2454	18871	.4211
20:03:13	2.5	-1.4	.0254	.1899	0	3611	28442	.4508
20:04:13	2.7	-2.3	.0352	.21091	0	3611	28442	.4508
20:04:13	1.4	-1.9	.0021	.50001	0	1742	15576	.4508
20:04:13	1.4	-1.3	.0021	.39715	0	2630	14630	.4508
20:04:13	3.1	-4.3	.0021	.31342	0	1944	4508	.16
20:04:13	3.3	-5.7	.0021	.31342	0	1942	16830	.4508
20:04:13	1.4	-1.5	.0021	.43299	0	1737	18584	.4508
20:04:13	3.8	-8.0	.0031	.52222	0	1463	22481	.4508
20:07:13	3.7	-9.0	.0028	.62002	0	1772	19384	.4508
20:07:13	4.0	-9.0	.0021	.50001	0	1742	15576	.4508
20:08:13	4.2	-10.0	.0016	.31627	0	1741	14630	.4508
20:08:13	4.4	-11.0	.0018	.35699	0	1489	14691	.4508
20:09:13	4.5	-12.0	.0023	.34918	0	1489	16974	.4508
20:09:13	4.7	-13.0	.0032	.61974	0	1774	16972	.4508

26 MAR 78												30 SECOND AVERAGE													
START	ALT	LUC-SC			LUC-101			LUC			LUC-SC			LUC-101			LUC			LUC-SC			LUC-101		
		TIME	MM	C	B/H*0.3	B/H*0.3	x	Cld	Un	N/H*0.3	x	Cld	Un	N/H*0.3	x	Cld	Un	N/H*0.3	x	Cld	Un	N/H*0.3	x	Cld	
15:50:09	7.1	-31.0	.0024	.0376	2	367	2573	2813	.49	16:18:09	7.3	-32.3	.0019	.0510	4	319	991	2448	.51						
15:50:09	7.1	-31.1	.0024	.0317	2	335	6101	5220	.50	16:18:39	7.3	-32.2	.0023	.0546	5	307	16438	2448	.51						
15:51:09	7.1	-31.1	.0025	.0425	2	342	63198	2813	.50	16:19:09	7.3	-32.2	.0023	.0520	5	305	7399	2448	.51						
15:51:09	7.1	-31.2	.0026	.0357	2	345	7479	2813	.53	16:19:39	7.3	-32.0	.0015	.0519	5	309	6039	2448	.51						
15:52:09	7.1	-31.3	.0026	.0320	2	337	9547	5220	.43	16:20:09	7.3	-32.0	.0015	.0253	12	276	6275	1431	.51						
15:52:09	7.1	-31.4	.0037	.1168	2	424	12728	5228	.37	16:20:39	7.3	-32.3	.0014	.0173	14	278	5454	2448	.51						
15:53:09	7.1	-31.4	.0032	.0676	3	424	7461	3848	.44	16:21:09	7.1	-30.9	.0018	.0183	22	224	7698	2122							
15:53:09	7.1	-31.4	.0035	.1129	2	437	12177	5228	.37	16:21:39	7.3	-32.7	.0013	.0159	53	178	8146	1886	.45						
15:54:09	7.1	-31.5	.0035	.1079	2	422	11994	5228	.40	16:22:09	7.3	-32.9	.0023	.0123	74	164	24513	1488	.47						
15:54:09	7.1	-31.5	.0034	.0904	2	372	10659	3158	.45	16:22:39	7.3	-33.2	.0019	.0166	48	183	5895	1886	.43						
15:55:09	7.1	-31.5	.0034	.0912	2	384	9211	5228	.48	16:23:09	7.3	-33.2	.0017	.0166	48	183	5895	1886	.43						
15:55:39	7.1	-31.1	.0027	.0713	1	354	7843	3503	.52	16:23:39	7.2	-32.3	.0014	.0157	31	268	8796	1886	.51						
15:56:09	7.1	-31.0	.0028	.0638	2	334	7217	3503	.51	16:24:09	7.1	-30.9	.0018	.0183	22	224	8124	2448	.51						
15:56:39	7.1	-30.9	.0028	.0533	3	325	7927	2813	.50	16:24:39	7.1	-29.7	.0008	.0098	5	11	274	2437	1008						
15:57:09	7.1	-31.0	.0022	.0179	5	299	2701	2468	.41	16:25:09	6.9	-28.0	.0007	.0087	11	291	4990	2448	.44						
15:57:39	7.1	-30.9	.0026	.0085	27	220	3236	1728	.58	16:25:39	6.0	-28.1	.0022	.0141	7	395	8797	2448	.44						
15:58:09	7.1	-31.1	.0032	.0175	14	232	4416	2468	.54	16:26:09	6.0	-27.3	.0022	.0167	13	273	9432	2448	.43						
15:58:39	7.2	-31.7	.0028	.0380	2	314	5341	2468	.37	16:26:39	6.5	-26.2	.0020	.0141	4	314	7995	2448	.43						
15:59:09	7.2	-32.1	.0029	.0251	9	228	5642	2468	.56	16:27:09	6.3	-24.9	.0010	.0155	26	362	4034	1433	.49						
15:59:39	7.2	-32.4	.0031	.0139	44	191	8162	1088	.55	16:27:39	6.2	-23.5	.0011	.0297	5	323	5624	2121	.50						
16:00:09	7.2	-32.4	.0031	.0103	33	209	4421	2133	.57	16:28:09	6.1	-22.8	.0010	.0319	5	383	4511	2448	.45						
16:00:39	7.2	-32.5	.0035	.0086	29	213	3130	1433	.53	16:28:39	5.9	-21.3	.0022	.0052	2	554	2291	2811	.38						
16:01:09	7.2	-32.2	.0042	.0113	25	223	4049	1433	.59	16:29:09	5.8	-20.4	.0051	.0170	3	569	17847	3866	.35						
16:01:39	7.2	-32.3	.0040	.0081	12	220	2156	2468	.53	16:29:39	5.7	-19.8	.0041	.0141	1	522	11247	5226	.34						
16:02:09	7.2	-32.2	.0025	.0655	16	243	2453	1088	.54	16:30:09	5.6	-19.5	.0004	.0209	2	539	14576	5226	.33						
16:02:39	7.2	-32.2	.0027	.0223	22	222	1433	5223	.54	16:30:39	5.6	-19.4	.0043	.0043	2	523	2131	4191	.37						
16:03:09	7.2	-32.4	.0020	.0103	18	2404	1433	50	16:31:09	5.6	-19.4	.0045	.0047	2	554	19612	5226	.33							
16:03:39	7.2	-32.7	.0016	.0158	14	249	5144	1433	.53	16:31:39	5.4	-19.7	.0052	.0253	2	524	16525	5226	.31						
16:04:09	7.2	-32.4	.0024	.0224	4	297	5090	2468	.57	16:32:09	5.6	-19.8	.0034	.0034	2	517	14994	5226	.32						
16:04:39	7.2	-32.3	.0017	.0212	7	292	5698	2468	.50	16:32:39	5.6	-19.8	.0033	.0179	2	549	14994	5226	.31						
16:05:09	7.2	-32.3	.0019	.0360	10	260	9901	2468	.52	16:33:09	5.4	-19.7	.0035	.0174	2	549	14994	5226	.31						
16:05:39	7.2	-32.0	.0016	.0280	36	233	12342	1433	.58	16:33:39	5.6	-19.5	.0040	.0176	1	523	14557	5226	.30						
16:06:09	7.2	-32.0	.0017	.0292	17	246	9232	2468	.51	16:34:09	5.6	-19.4	.0042	.0167	2	499	13419	5226	.30						
* 16:06:39	7.2	-32.3	.0010	.0160	45	187	8656	2468	.53	16:34:39	5.6	-19.3	.0043	.0177	3	429	15274	3563	.46						
* 16:07:09	7.2	-32.3	.0014	.0300	35	204	11482	1433	.53	16:35:09	5.6	-19.3	.0008	.0126	4	411	15267	4063	.41						
* 16:07:39	7.2	-32.3	.0016	.0326	18	242	9751	2468	.55	16:35:39	5.6	-19.4	.0033	.0183	4	462	14248	4063	.42						
16:08:09	7.2	-32.4	.0007	.0059	32	179	3625	1728	.49	16:36:09	5.6	-19.7	.0041	.0141	2	349	14248	4063	.42						
16:08:39	7.2	-32.4	.0019	.0351	14	233	12343	1433	.58	16:36:39	5.7	-19.7	.0011	.0252	19	259	7277	2448	.46						
16:09:09	7.2	-32.5	.0013	.0220	5	361	4446	2468	.53	16:37:09	5.7	-20.0	.0008	.0184	7	323	1499	2121	.47						
16:09:39	7.2	-32.5	.0014	.0270	15	239	7281	1728	.52	16:37:39	5.7	-20.1	.0007	.0126	10	592	8465	5226	.46						
16:10:09	7.2	-32.7	.0007	.0165	24	223	6998	1728	.55	16:38:09	5.7	-20.0	.0008	.0126	1	497	1627	5226	.45						
16:10:39	7.2	-32.4	.0016	.0275	9	288	5347	2613	.53	16:38:39	5.7	-19.9	.0033	.0142	2	317	11119	5226	.45						
16:11:09	7.2	-32.4	.0007	.0091	17	257	2323	2468	.50	16:39:09	5.7	-20.0	.0032	.0176	2	444	1627	5226	.45						
16:11:39	7.2	-32.4	.0016	.0280	46	184	3533	1433	.57	16:39:39	5.7	-20.0	.0028	.0159	3	478	17972	3563	.46						
16:12:09	7.2	-32.5	.0014	.0184	4	297	4262	2468	.53	16:40:09	5.7	-19.8	.0043	.0261	3	512	4664	5226	.45						
16:12:39	7.2	-32.4	.0013	.0189	23	226	6458	1728	.54	16:40:39	5.7	-19.8	.0047	.0159	2	432	11608	2121	.46						
16:13:09	7.2	-32.7	.0007	.0145	24	223	6998	1728	.55	16:41:09	5.7	-19.7	.0022	.0126	1	497	1627	5226	.45						
16:13:39	7.2	-32.4	.0016	.0273	16	216	3723	2468	.52	16:41:39	5.7	-20.0	.0032	.0176	2	444	1627	5226	.45						
16:14:09	7.2	-32.4	.0012	.0134	15	247	3467	1728	.50	16:42:09	5.7	-20.0	.0032	.0176	2	444	1627	5226	.45						
16:14:39	7.2	-32.4	.0016	.0280	5	293	3353	1433	.59	16:42:39	5.7	-20.0	.0028	.0159	3	478	17972	3563	.46						
16:15:09	7.2	-32.5	.0014	.0184	4	294	42																		

START TIME	ALT KM	26 MAR 78			30 SECOND AVERAGE			26 MAR 78			30 SECOND AVERAGE					
		TEMP C	LUC-SC 6/Ne-3	LUC-TOT LUC 6/Ne-3 1 CLD	DO W/Ne-3	NT W/Ne-3	ALT KM	LUC-SC C	LUC-TOT LUC 8/Ne-3 2 CLD	DO W/Ne-3	NT W/Ne-3	ALT KM	LUC-SC C	LUC-TOT LUC 8/Ne-3 2 CLD	DO W/Ne-3	NT W/Ne-3
164459 5.6 -18.9	.0096	.0061	.31	215	2309	1433	.52	17144.09	3.0	-2.7	.0074	1.8953	1	1564	27402	.15
164459 5.6 -19.2	.0014	.0033	.10	310	6028	2468	.44	17144.39	3.0	-2.4	.0026	1.8953	1	18722	5229	.15
164459 5.6 -19.3	.0014	.0024	.3	334	4522	2468	.50	17144.69	3.0	-2.4	.0043	1.9121	0	1697	18450	.18
164459 5.6 -19.4	.0021	.0054	.3	342	5923	2468	.49	17145.39	3.0	-2.5	.0023	.4899	0	1141	27810	.13
164459 5.6 -19.4	.0012	.0039	.3	349	5120	2813	.46	17146.09	3.0	-2.7	.0024	1.1384	7	1270	52293	.11
164459 5.6 -19.2	.0022	.0079	.2	392	8800	3503	.41	17146.39	3.0	-2.3	.0049	1.8772	3	1632	18121	.17
164459 5.6 -19.2	.0032	.0109	.2	412	11078	5229	.32	17147.09	3.0	-2.4	.0073	2.1629	2	1629	18760	.18
164459 5.6 -19.3	.0028	.0102	.2	453	9541	5228	.31	17147.39	3.0	-2.3	.0031	1.1092	2	1343	18149	.23
164459 5.6 -19.4	.0024	.0137	.4	437	9499	3503	.31	17148.09	3.0	-2.3	.0074	2.4239	2	1590	21648	.19
164500 5.7 -19.5	.0015	.0047	.4	362	5689	3503	.37	17148.39	3.0	-2.5	.0070	2.5379	2	1511	60135	.12
164500 5.7 -19.5	.0015	.0039	.3	485	19223	5228	.34	17149.09	3.0	-2.4	.0143	2.1545	3	1416	17741	.16
164500 5.7 -19.7	.0016	.0072	.2	418	7561	4883	.36	17149.39	3.0	-2.3	.0072	1.593	4	1645	34913	.19
164500 5.7 -19.7	.0022	.0109	.3	447	11320	3158	.39	17149.69	3.0	-2.3	.0054	4.3425	2	1645	28266	.21
164500 5.7 -19.7	.0039	.0167	.2	459	19954	5228	.36	17150.09	3.0	-2.3	.0102	2.4464	2	1481	17348	.21
164500 5.7 -19.6	.0032	.0109	.2	412	11078	3158	.40	17150.39	3.0	-2.7	.0025	2.0892	3	1482	11548	.19
164500 5.7 -19.6	.0024	.0129	.4	418	13441	3158	.41	17151.09	3.0	-2.7	.0004	1.2715	4	1427	33447	.15
164500 5.7 -19.6	.0028	.0148	.3	440	13586	3848	.41	17151.39	3.0	-2.9	.0010	1.6510	4	1625	27918	.13
164500 5.7 -19.6	.0035	.0139	.2	485	19223	5228	.34	17151.69	3.0	-2.7	.0035	1.0527	14	1192	75458	.09
* 164500 5.7 -19.5	.0035	.0207	.2	465	19883	5228	.33	17152.09	3.0	-2.5	.0024	1.3462	12	1375	82444	.08
* 164500 5.7 -19.5	.0035	.0213	.2	534	15134	5228	.29	17152.39	3.0	-2.4	.0097	2.5445	2	1546	5229	.08
* 164500 5.7 -19.6	.0032	.0269	.2	521	16494	5228	.36	17152.69	3.0	-2.4	.0097	2.5445	2	1546	5229	.15
* 164500 5.7 -19.6	.0032	.0269	.2	455	17142	5228	.31	* 17153.09	3.0	-2.4	.0097	2.5445	2	1546	5229	.15
164510 5.7 -19.5	.0032	.0280	.2	440	13586	3848	.41	17153.39	3.0	-2.2	.0067	4.5458	3	1487	42974	.20
164510 5.7 -19.5	.0032	.0280	.2	440	13586	3848	.41	17153.69	3.0	-2.1	.0062	3.7725	3	1458	5229	.21
164510 5.7 -19.4	.0032	.0280	.2	485	19223	5228	.34	17154.09	3.0	-2.0	.0064	3.7571	1	1577	20970	.23
164510 5.7 -19.4	.0033	.0284	.2	485	19883	5228	.33	17154.39	3.0	-2.0	.0030	2.7676	2	1522	14118	.23
164510 5.7 -19.4	.0035	.0287	.2	465	19883	5228	.33	17154.69	3.0	-2.3	.0040	1.5922	2	1295	48642	.29
164510 5.7 -19.4	.0035	.0287	.2	534	15134	5228	.29	17155.09	3.0	-2.4	.0077	1.1494	3	1197	21628	.26
164510 5.7 -19.5	.0032	.0269	.2	455	17142	5228	.31	17155.39	3.0	-2.4	.0097	2.5445	2	1546	5229	.16
164510 5.7 -19.5	.0032	.0280	.2	440	13586	3848	.41	17155.69	3.0	-2.2	.0067	4.5458	3	1487	42974	.20
164510 5.7 -19.4	.0032	.0280	.2	440	13586	3848	.41	17156.09	3.0	-2.1	.0062	3.7725	3	1458	5229	.21
164510 5.7 -19.4	.0032	.0280	.2	485	19223	5228	.34	17156.39	3.0	-2.0	.0064	3.7571	1	1577	20970	.23
164510 5.7 -19.4	.0032	.0280	.2	485	19883	5228	.33	17156.69	3.0	-2.0	.0030	2.7676	2	1522	14118	.23
164510 5.7 -19.4	.0035	.0287	.2	465	19883	5228	.33	17157.09	3.0	-2.3	.0040	1.5922	2	1295	48642	.29
164510 5.7 -19.5	.0032	.0269	.2	455	17142	5228	.31	17157.39	3.0	-2.4	.0097	2.5445	2	1546	5229	.16
164510 5.7 -19.5	.0032	.0280	.2	440	13586	3848	.41	17157.69	3.0	-2.2	.0067	4.5458	2	1478	23428	.18
164510 5.7 -19.4	.0032	.0280	.2	440	13586	3848	.41	17158.09	3.0	-2.1	.0062	3.7725	3	1458	5229	.21
164510 5.7 -19.4	.0032	.0280	.2	485	19223	5228	.34	17158.39	3.0	-2.0	.0064	3.7571	1	1577	20970	.23
164510 5.7 -19.4	.0032	.0280	.2	485	19883	5228	.33	17158.69	3.0	-2.0	.0030	2.7676	2	1522	14118	.23
164510 5.7 -19.4	.0035	.0287	.2	465	19883	5228	.33	17159.09	3.0	-2.3	.0040	1.5922	2	1295	48642	.29
164510 5.7 -19.5	.0032	.0269	.2	455	17142	5228	.31	17159.39	3.0	-2.4	.0097	2.5445	2	1546	5229	.16
164510 5.7 -19.5	.0032	.0280	.2	440	13586	3848	.41	17159.69	3.0	-2.2	.0067	4.5458	2	1478	23428	.18
164510 5.7 -19.4	.0032	.0280	.2	440	13586	3848	.41	17160.09	3.0	-2.1	.0062	3.7725	3	1458	5229	.21
164510 5.7 -19.4	.0032	.0280	.2	485	19223	5228	.34	17160.39	3.0	-2.0	.0064	3.7571	1	1577	20970	.23
164510 5.7 -19.4	.0032	.0280	.2	485	19883	5228	.33	17160.69	3.0	-2.0	.0030	2.7676	2	1522	14118	.23
164510 5.7 -19.4	.0035	.0287	.2	465	19883	5228	.33	17161.09	3.0	-2.3	.0040	1.5922	2	1295	48642	.29
164510 5.7 -19.5	.0032	.0269	.2	455	17142	5228	.31	17161.39	3.0	-2.4	.0097	2.5445	2	1546	5229	.16
164510 5.7 -19.5	.0032	.0280	.2	440	13586	3848	.41	17161.69	3.0	-2.2	.0067	4.5458	2	1478	23428	.18
164510 5.7 -19.4	.0032	.0280	.2	440	13586	3848	.41	17162.09	3.0	-2.1	.0062	3.7725	3	1458	5229	.21
164510 5.7 -19.4	.0032	.0280	.2	485	19223	5228	.34	17162.39	3.0	-2.0	.0064	3.7571	1	1577	20970	.23
164510 5.7 -19.4	.0032	.0280	.2	485	19883	5228	.33	17162.69	3.0	-2.0	.0030	2.7676	2	1522	14118	.23
164510 5.7 -19.4	.0035	.0287	.2	465	19883	5228	.33	17163.09	3.0	-2.3	.0040	1.5922	2	1295	48642	.29
164510 5.7 -19.5	.0032	.0269	.2	455	17142	5228	.31	17163.39	3.0	-2.4	.0097	2.5445	2	1546	5229	.16
164510 5.7 -19.5	.0032	.0280	.2	440	13586	3848	.41	17163.69	3.0	-2.2	.0067	4.5458	2	1478	23428	.18
164510 5.7 -19.4	.0032	.0280	.2	440	13586	3848	.41	17164.09	3.0	-2.1	.0062	3.7725	3	1458	5229	.21
164510 5.7 -19.4	.0032	.0280	.2	485	19223	5228	.34	17164.39	3.0	-2.0	.0064	3.7571	1	1577	20970	.23
164510 5.7 -19.4	.0032	.0280	.2	485	19883	5228	.33	17164.69	3.0	-2.0	.0030	2.7676	2	1522	14118	.23
164510 5.7 -19.4	.0035	.0287	.2	465	19883	5228	.33	17165.09	3.0	-2.3	.0040	1.5922	2	1295	48642	.29
164510 5.7 -19.5	.0032	.0269	.2	455	17142	5228	.31	17165.39	3.0	-2.4	.0097	2.5445	2	1546	5229	.16
164510 5.7 -19.5	.0032	.0280	.2	440	13586	3848	.41	17165.69	3.0	-2.2	.0067	4.5458	2	1478	23428	.18
164510 5.7 -19.4	.0032	.0280	.2	440	13586	3848	.41	17166.09	3.0	-2.1	.0062	3.7725	3	1458	5229	.21
164510 5.7 -19.4	.0032	.0280	.2	485	19223	5228	.34	17166.39	3.0	-2.0	.0064	3.7571	1	1577	20970	.23
164510 5.7 -19.4	.0032	.0280	.2	485	19883	5228	.33	17166.69	3.0	-2.0	.0030	2.7676	2	1522	14118	.23
164510 5.7 -19.4	.0035	.0287	.2	465	19883	5228										

26 MARCH 78												26 MARCH 78											
30 SECOND AVERAGE				LNC-101 LOC				LNC-101 LOC				30 SECOND AVERAGE				LNC-101 LOC				LNC-101 LOC			
START	TIME	ALT	TEMP	LNC-SC	LNC-SC	DO	FF	START	TIME	ALT	TEMP	LNC-SC	LNC-SC	DO	FF	START	TIME	ALT	TEMP	LNC-SC	LNC-SC	DO	FF
		km	C	6/Ne+3	6/Ne+3	CLB	UN			km	C	6/Ne+3	6/Ne+3	CLB	UN			km	C	6/Ne+3	6/Ne+3	CLB	UN
174209	1.5	5.2	.0018	-1724	0	1232	1111	174209	3.4	2429	3.2	16110109	3.2	124226	3.0	2517	3.4	2429	3.2	16110109	3.2	124226	3.0
1742139	1.5	4.9	.0029	-1561	-	1345	2253	1742139	.17	18101039	3.4	18111039	3.4	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1743109	1.5	5.0	.0274	-1741	4	1221	13611	1743109	.04	18111039	3.4	18111039	3.4	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1743139	1.5	5.3	.0091	-1075	3	915	4128	1743139	.17	18111039	3.4	18111039	3.4	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1744109	1.5	5.4	.0185	-1383	1	1075	8118	1744109	.12	18111039	3.4	18111039	3.4	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1744139	1.5	5.4	.0230	-1722	3	1170	19426	1744139	.03	18111039	3.4	18111039	3.4	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1745109	1.5	5.7	.0084	-1524	-	1183	1615	1745109	.12	18111039	4.2	18111039	4.2	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1745139	1.5	5.0	.0190	-1945	1	1106	4811	1745139	.11	18111039	4.4	18111039	4.4	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1746109	1.5	5.4	.0012	-2580	0	1341	2594	1746109	.21	18111039	4.5	18111039	4.5	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1746139	1.5	5.8	.0009	-3048	2	1370	3041	1746139	.21	18111039	4.7	18111039	4.7	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1747109	1.5	6.2	.0013	-3762	1	1607	4075	1747109	.15	18111039	4.9	18111039	4.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1747139	1.5	7.0	.0011	-5169	1	1845	4400	1747139	.09	18111039	5.0	18111039	5.0	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1748109	1.5	6.3	.0016	-5588	0	1655	4204	1748109	.14	18111039	5.1	18111039	5.1	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1748139	1.4	6.7	.0013	-4611	1	1600	5001	1748139	.16	18111039	5.2	18111039	5.2	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1749109	1.4	6.5	.0010	-3759	1	1488	3727	1749109	.12	18111039	5.4	18111039	5.4	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1749139	1.4	6.3	.0010	-3619	1	1399	3431	1749139	.20	18111039	5.4	18111039	5.4	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1750109	1.5	6.7	.0012	-4467	1	1600	3712	1750109	.12	18111039	5.5	18111039	5.5	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1750139	1.5	6.0	.0017	-4772	1	1481	4372	1750139	.17	18111039	5.6	18111039	5.6	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1751109	1.5	6.2	.0010	-3582	2	1395	4395	1751109	.16	18111039	5.6	18111039	5.6	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1751139	1.5	5.4	.0013	-5101	1	1649	5163	1751139	.11	18111039	5.7	18111039	5.7	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1752109	1.5	5.2	.0021	-5923	1	1583	5534	1752109	.17	18111039	5.8	18111039	5.8	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1753109	1.5	5.3	.0011	-4276	1	1519	5187	1753109	.16	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1753139	1.5	5.5	.0017	-6240	2	1691	6117	1753139	.12	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1754109	1.5	5.1	.0015	-5229	1	1653	6332	1754109	.18	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1754139	1.5	4.7	.0012	-5334	1	1550	5784	1754139	.18	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1755109	1.5	4.9	.0020	-4485	1	1726	8359	1755109	.17	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1755139	1.5	4.7	.0036	-6413	1	1782	15144	1755139	.11	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1756109	1.5	4.8	.0035	-5483	2	1576	7024	1756109	.15	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1756139	1.5	5.1	.0024	-3320	1	1461	4571	1756139	.13	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1757109	1.5	5.4	.0018	-3892	1	1353	4447	1757109	.16	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1757139	1.5	5.7	.0024	-2924	1	1475	3711	1757139	.18	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
* 1758109	1.5	5.4	.0041	-2395	1	1412	4308	1758109	.15	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
* 1758139	1.5	4.1	.0011	-2377	-	1396	3320	1758139	.13	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
* 1759109	1.5	5.5	.0051	-2874	1	1498	3741	1759109	.14	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
* 1759139	1.5	5.2	.0064	-3197	1	1572	3728	1759139	.14	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1800109	1.5	5.4	.0038	-2895	2	1550	4841	1800109	.14	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1800139	1.5	5.7	.0177	-1451	1	1477	3958	1800139	.13	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1801109	1.5	4.7	.0187	-3864	1	1665	8377	1801109	.10	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1801139	1.5	4.3	.0141	-5079	2	1712	8011	1801139	.10	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1802109	1.5	4.1	.0092	-2497	1	1592	3741	1802109	.13	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1802139	1.5	4.4	.0050	-2131	1	1431	3402	1802139	.14	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1803109	1.5	4.7	.0021	-1462	1	1408	4602	1803109	.12	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1803139	1.5	4.9	.0011	-2237	1	1771	2386	1803139	.13	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1804109	1.5	5.1	.0045	-2132	1	1479	2525	1804109	.14	18111039	5.9	18111039	5.9	18111039	.04	2433	22926	22926	22926	22926	22926	22926	
1804139	1.5	5.1	.0014	-2413	0	1524																	

FILME

